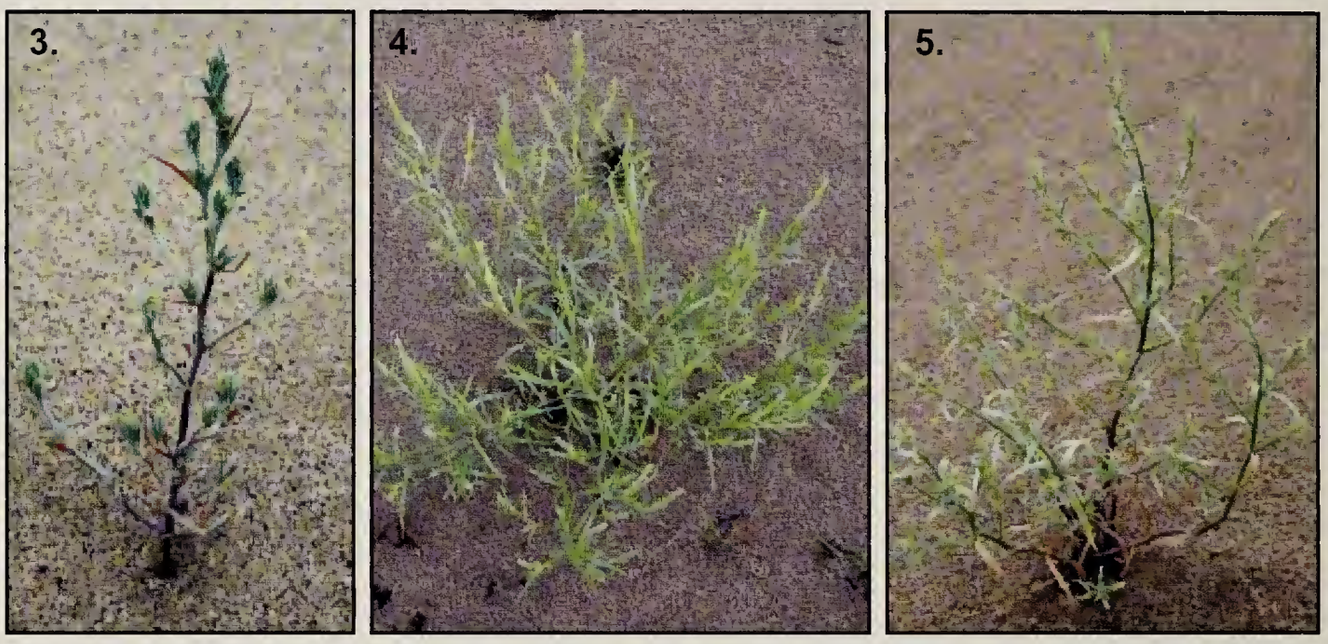
BLUE JAY

Volume 68 Number 4 December 2010

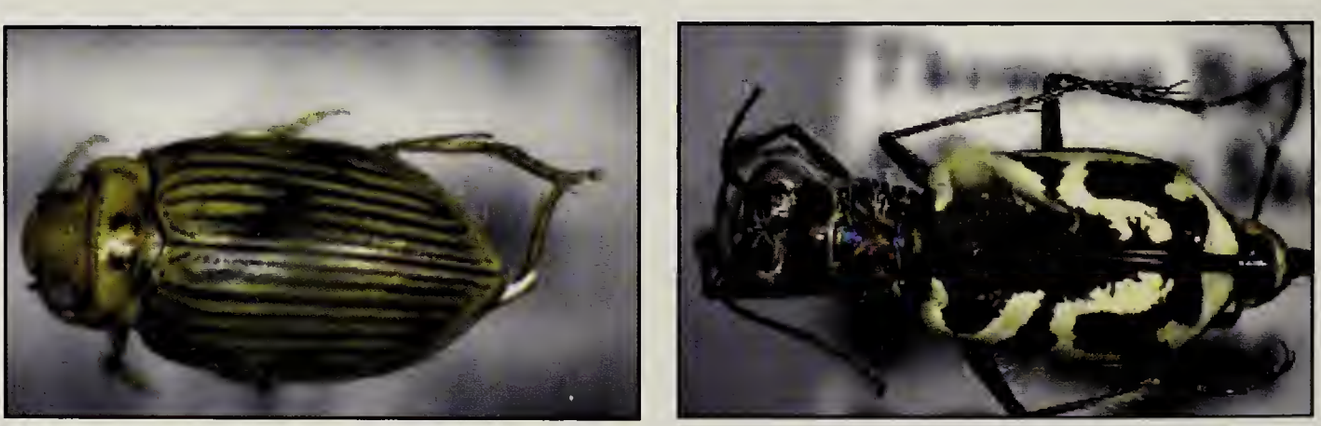
Fr *more on the status of these salamanders in Manitoba, see articles by Hewson & Watkins on p. 184 and P. Taylor on p. 190.* *Peter Taylor*

Back cover: *Sharp-shinned hawk* (Accipiter striatus) *showing nictitating membrane covering its left eye. This individual is an immature, as evidenced by the pale yellow iris and the breast feather pattern, which runs lengthwise from the breast to the belly. For more on sharp-shins, see article by R. Dickson on p. 179.*

Ross Dickson



Figures 3-5: 3. American bugseed (Corispermum americanum) *at CFB Shilo, MB. 4. Hooker's bugseed* (C. hookeri) *in Spruce Woods Provincial Park, MB. 5. Hairy bugseed* (C. villosum) *at CFB Shilo, MB. See article by D. Bizecki Robson on p. 199.* *Diana Bizecki Robson*



Figures 1 & 2: 1. Predaceous diving beetle Stictotarsus minipi *Larson. 2. Sand-associated tiger beetle* Cicindela limbata hyperborea *Wallis. See note by R. Hooper on p. 218.* *Ronald Hooper*

Blue Jay

Vol. 68 No. 4 December 2010 173-240

Birds

NEW 'MONITORING AVIAN PRODUCTIVITY AND SURVIVAL' (MAPS) STATION ESTABLISHED IN WASCANA CENTRE, REGINA, SASKATCHEWAN, SUMMER 2010. *Jared B. Clarke and Bob Ewart* 174

SHARP-SHINNED HAWK MONITORING AT LAST MOUNTAIN REGIONAL PARK – AUTUMN 2004. *Ross D. Dickson* 179

Amphibians

UPDATE ON THE RANGE AND DISTRIBUTION OF BLUE-SPOTTED SALAMANDERS IN MANITOBA. *Shauna Hewson and William G. Watkins* 184

SEASONAL MOVEMENTS OF BLUE-SPOTTED SALAMANDERS AT PINAWA, MANITOBA. *Peter Taylor* 190

Plants

THE BUGSEEDS *(CORISPERMUM)* OF THE PRAIRIE PROVINCES. *Diana Bizecki Robson* 199

Human Dimensions

ENHANCING CONSERVATION BENEFITS FROM WILDLIFE FESTIVALS AND ECOTOURISM ACTIVITIES. *Glen T. Hvenegaard and Nhial Tiitmamer Kur* 208

Notes and Letters

THE REDISCOVERY OF *STICTOTARSUS MINIPI* LARSON (INSECTA: COLEOPTERA: DYTISCIDAE) IN LAKE ATHABASCA, SASKATCHEWAN. *Ronald R. Hooper* 218

NATURE SASKATCHEWAN FALL MEET 2010 AWARD WINNERS (PHOTO COLLAGE) 219

Nature Library

BIRDS OF CANADA. *Tyler L. Hoar, Ken de Smet, R. Wayne Campbell, and Gregory Kennedy* 221

GRASSHOPPER IDENTIFICATION AND CONTROL METHODS TO PROTECT CROPS AND THE ENVIRONMENT. *Dan L. Johnson* 222

Mystery Photo 224

Index to Volume 68. *Teresa Dolman* 225

THIS ORGANIZATION RECEIVES FUNDING FROM:

Saskatchewan LOTTERIES LOTTERY TICKET CENTRE

BIRDS

NEW 'MONITORING AVIAN PRODUCTIVITY AND SURVIVAL' (MAPS) STATION ESTABLISHED IN WASCANA CENTRE, REGINA, SASKATCHEWAN, SUMMER 2010

Jared B. Clarke[1], Bob Ewart

Wascana Centre Authority, Box 7111, Regina, SK, S4P 3S7

[1]E-mail: <jared.clarke@wascana.sk.ca>

The 'Monitoring Avian Productivity and Survival' (MAPS) Program was established in 1989 by David DeSantes and the Institute for Bird Populations. There are currently over 500 MAPS stations across North America, with only three active stations in Saskatchewan, including Wascana Centre in Regina, SK. The program aims to monitor the population dynamics of North American landbird species. Banding stations set up mist nets and capture, band, age, and sex birds. With this information, it is possible to determine annual survival and reproduction estimates for many of the species captured. Population trends of the station's breeding bird populations can then be determined (e.g., within Wascana Centre). These trends can also be compared to other areas of similar habitat. On a large scale, the data can also be used to understand how broad landscape features influence survival and reproduction.

In 1975, a nesting survey was conducted in the Waterfowl Park (WP), within Wascana Centre.[1] This survey encompassed the entire WP, which includes the Habitat Conservation Area (HCA; see Fig. 1). Donison (1976) confirmed breeding records for 67 species within the WP.[1] This survey provided an impressive amount of information, but was conducted in an opportunistic searching pattern. There has never been a standardized study conducted in Wascana Centre to monitor population trends of resident songbird species. Therefore, in 2010, Wascana Centre established a MAPS station to study the local breeding bird species. Here we discuss the results of the first year of monitoring.

Methods

Study site. Wascana's MAPS station is set up in the HCA (Fig. 1), a fenced area that was set aside for wildlife in 1962. The HCA is located along Wascana Creek within the city of Regina, SK. The University of Regina sits opposite the HCA on the other side of the creek. The area was formerly privately owned and used as market gardens. The main habitat is a planted tame grassland, dominated by crested wheatgrass (*Agropyron cristum*) and smooth bromegrass (*Bromus inermis)*. Some native wildflowers, including goatsbeard (*Tragopogon dubius*), wooly yarrow (*Achillea millefolium*), and Canada anenome (*Anemone canadensis*) can be found here as well. *Caragana* sp.

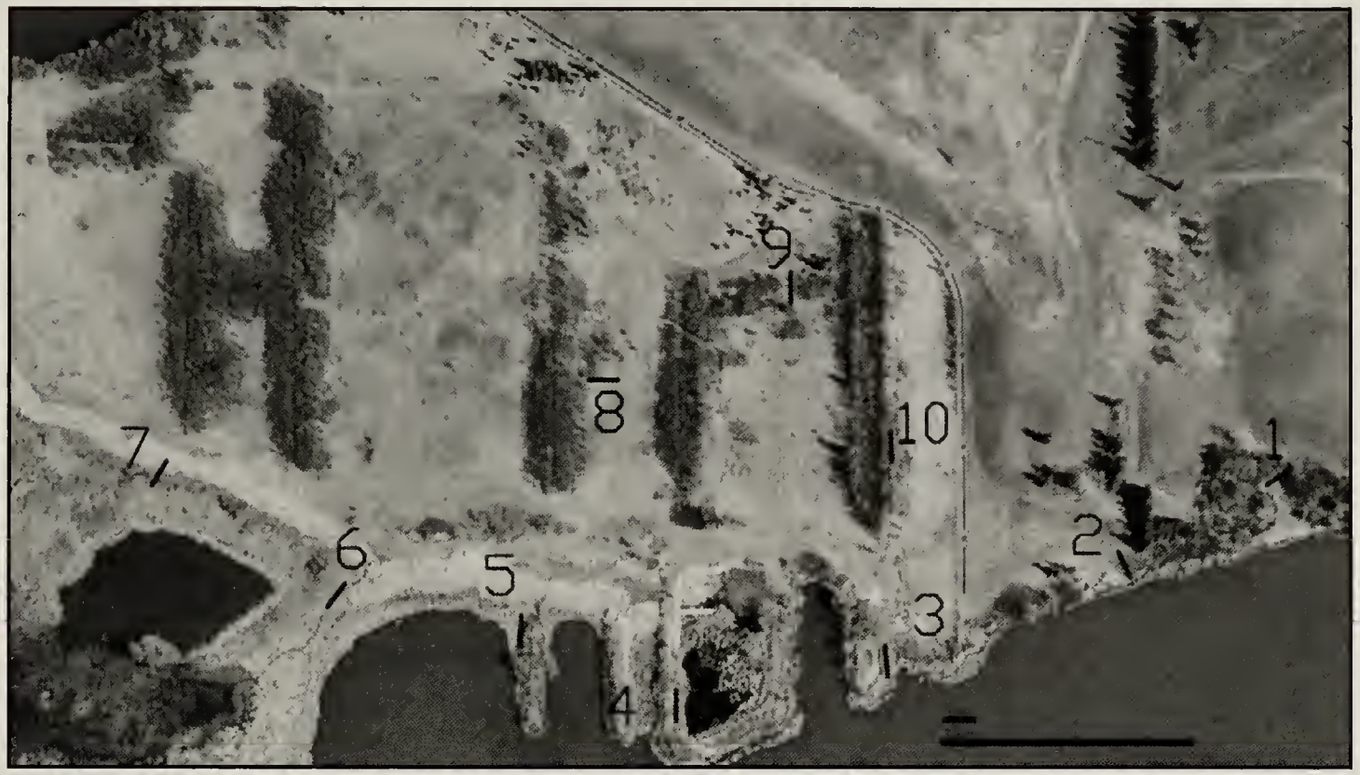


Figure 1. Net locations of the Wascana MAPS station, within Wascana Centre, Regina, SK. The perimeter fence around the Habitat Conservation Area starts to the right of net 3, extends north and then northwest. Nets 1 and 2 are outside of the HCA. Note that the H-shaped Caragana row on the west side of the HCA was removed in 2009.

hedgerows originally used to delineated individual properties have spread dramatically; however, a large portion of these rows was removed in 2009. The south and west sides of the HCA are bordered by Wascana Creek and surrounding marsh dominated by cattails (*Typha* sp.), bulrush (*Scirpus* sp.), and willow (*Salix* sp.).

Netting. Following standardized MAPS protocol, mist nets were used at the station for 6 days during summer 2010 as follows: 15 and 26 June; 7, 16, and 30 July; and 6 August. Ten 12-m mist nets were set up within the HCA, spaced approximately 50 to 100 m apart. Nets were opened at sunrise at each session and closed 6 h later. Mist nets were checked approximately every 30 min for captured birds. All birds were removed from the net, placed in a cloth bag, and taken to the banding station for processing. Each bird was banded, weighed, sexed, and aged (e.g., see Fig. 2, inside back cover, top). We also collected a variety of morphological information, including development of a brood patch, cloacal protuberance, fat deposits, and feather moult and wear. Once the measurements were complete, the bird was released.

Observations. Observations were also made of all birds seen/heard during each session. Based on the behaviour or general observation made, breeding status was assigned as Confirmed (current nest found, carrying nesting material, carrying food, distraction display, or local, just fledged, bird present); Probable (courtship/copulation, territorial behaviour, song); or Observed (banded, encountered, flyover). After all sessions were completed, year status was assigned as Breeder, Likely Breeder, Transient, or Migrant.

Results

Netting. In total, nets were open for 36 h (432 net-hours), and 386 birds of 26 species were captured. Of those, 332

Table 1. Species and total birds captured as part of the Wascana MAPS station within the Habitat Conservation Area during the 2010 breeding season. Recaps: recaptures.

Species	Total	
	Banded	Recaps
Yellow Warbler	99	18
Gray Catbird	38	11
American Robin	28	2
Red-winged Blackbird	27	1
American Goldfinch	24	4
Clay-colored Sparrow	14	2
Cedar Waxwing	12	4
Common Yellowthroat	12	3
Least Flycatcher	11	1
House Wren	9	2
Song Sparrow	9	2
Yellow-headed Blackbird	9	1
Trail's Flycatcher	7	0
Brown Thrasher	6	0
Warbling Vireo	5	1
Marsh Wren	4	1
Brown-headed Cowbird	3	1
Tennessee Warbler	3	0
Western Kingbird	3	0
Chipping Sparrow	2	0
Sora	2	0
Barn Swallow	1	0
Common Grackle	1	0
House Finch	1	0
Lincoln's Sparrow	1	0
Northern Flicker	1	0
Total	**332**	**54**

were newly banded, while 54 recaptures were made during a later session (Table 1). Therefore, the capture rate was 0.9 birds per net-hour. Comparisons of age classes were made of the four species that were most frequently captured this summer (HY: Hatch Year, SY: Second Year, ASY: After Second Year, AHY: After Hatch Year; Table 2). The proportion of HY birds was relatively high (>40%) for yellow warblers (*Dendroica petechia*), gray catbirds (*Dumetella carolinensis*), and American robins (*Turdus migratorius*), while only a small proportion of HY red-winged blackbirds (*Agelaius phoeniceus*) were captured.

Table 2. Age classes of the four most-frequently captured species at the Wascana MAPS station in 2010. HY: Hatch Year, SY: Second Year, ASY: After Second Year, AHY: After Hatch Year

Species	Age Class			
	HY (%)	SY (%)	ASY (%)	AHY (%)
Yellow Warbler	41 (41)	27 (27)	21 (21)	10 (10)
Gray Catbird	20 (53)	3 (8)	14 (37)	1 (3)
American Robin	20 (71)	4 (14)	3 (11)	1 (4)
Red-winged Blackbird	6 (22)	7 (26)	14 (52)	0

Observations. During the six sessions, 49 species were observed within the study area (Table 3). Breeding was confirmed for 23 species, breeding was likely for an additional 19 species, and five transient species and two migrant species were also observed. We also compared the species list from the study conducted in Waterfowl Park in 1976 (Table 3). Nineteen species that were present in 1975 were absent in 2010. Conversely, eight species that were documented in 2010 were not noted in 1975, four of which were Breeders or Likely Breeders.

Discussion

This is the first time a standardized study focusing on breeding birds within Wascana Centre has been undertaken. Because 2010 was the first year of the study, we have no current data to which we can compare our results. Donison's (1976) methodology was completely different from that of our study,[1] and therefore, no large-scale comparisons between the data sets can be made. We are able to simply compare the two lists of species noted during the two studies (see Table 3).

It is possible to compare age classes within species from this breeding season to determine potential nesting success. Table 2 shows that high proportions of young birds were captured for

Table 3. Breeding status of bird species identified during the Wascana MAPS station's first year of operation (2010) and of those noted by Donison (1976).[1] Breeding status was assigned based on results from 2010. B: Breeder, LB: Likely Breeder, T: Transient, M: Migrant, X: documented in 1975, but not in 2010. Species highlighted in bold were observed in 2010, but not in 1975. Note that species not observed near the Habitat Conservation Area in 1975 have been omitted.

Species	Breeding Status	Species	Breeding Status	Species	Breeding Status
Canada Goose	B	Common Tern	X	American Robin	B
Gadwall	B	Forster's Tern	X		
American Wigeon	B	Black Tern	T	Gray Catbird	B
Mallard	B			Brown Thrasher	B
Blue-winged Teal	LB	Rock Pigeon	LB		
Northern Shoveller	X	Mourning Dove	LB	European Starling	X
Northern Pintail	LB				
Green-winged Teal	X	Black-billed Cuckoo	X	Cedar Waxwing	B
Canvasback	LB				
Redhead	X	**Belted Kingfisher**	M	**Tennessee Warbler**	M
Ruddy Duck	LB			Yellow Warbler	B
		Downy Woodpecker	LB	Northern Waterthrush	X
Gray Partridge	LB	Northern Flicker	B	Common Yellowthroat	B
Pied-billed Grebe	LB	Least Flycatcher	B	Chipping Sparrow	B
Eared Grebe	B	Western Kingbird	B	Clay-colored Sparrow	B
Western Grebe	LB	Eastern Kingbird	B	Vesper Sparrow	X
				Savannah Sparrow	X
American White Pelican	T	Loggerhead Shrike	X	**Nelson Sharp-tailed Sparrow**	LB
Double-crested Cormorant	T			Song Sparrow	B
		Warbling Vireo	B		
American Bittern	X			Red-winged Blackbird	B
		American Crow	LB	Western Meadowlark	X
Cooper's Hawk	LB			Yellow-headed Blackbird	B
		Horned Lark	X	Brewer's Blackbird	X
Merlin	LB			Common Grackle	B
		Purple Martin	LB	Brown-headed Cowbird	B
Sora	B	Tree Swallow	LB	Baltimore Oriole	
American Coot	X	Bank Swallow	X		
		Barn Swallow	LB	American Goldfinch	B
Killdeer	LB			**House Finch**	B
		House Wren	B		
Spotted Sandpiper	X	Marsh Wren	B		
Wilson's Phalarope	X				

yellow warblers, gray catbirds, and American robins during the breeding season, suggesting that these birds had good local reproductive success in 2010. Interestingly, low numbers of adult American robins were captured. This capture rate is likely low due to the adults' ability to escape from the nets because of their large size (i.e. they are too large for the mist net holes) in addition to the adults' behaviour of continually struggling once captured in the net and typically escaping. Only 22% of red-winged blackbirds captured were HY birds, which is much lower than the other three species, suggesting that this species did not have as successful a breeding season. However, it is more likely that the earlier nesting behaviour of red-winged blackbirds would have resulted in fledged young and adults already dispersing from the area by the first session on 16 June. More in-depth analysis will be available

for most species once multiple years of data have been acquired.

Acknowledgements

The Wascana Centre Authority (WCA) thanks the numerous volunteers who came out and helped us each session. Special thanks to A. Crosby, J. Martino, G. Sheperd, A. Fortney, T. Vass, R. Fisher, G. Foley, and the crew from Nature Conservancy of Canada. We also acknowledge the dedication of R. Clarke, who attended each session to ensure that quality data were collected during the banding process. WCA thanks the Friends of Wascana Marsh for their financial support needed to establish this station. Thanks also to S. Davis for comments on an earlier draft of this manuscript. **Visit Wascana Centre's website for more information about the Centre and our monitoring programs: www.wascana.ca.**

1. Donison R (1976) Regina Waterfowl Park nesting survey. *Blue Jay* 34:103-116.

Great egret (Ardea alba), *photographed at Highfield Dam, southwest of Herbert, SK, on 27 September 2010. The last time it was seen was on 3 October.*

Randy McCulloch

SHARP-SHINNED HAWK MONITORING AT LAST MOUNTAIN REGIONAL PARK, SASKATCHEWAN

Ross D. Dickson

Last Mountain Bird Observatory, Box 154, Avonlea, SK, S0H 0C0

Figure 1. Sharp-shinned hawk. *Alan R. Smith*

Thousands of small birds are counted, captured, and banded each year at Last Mountain Bird Observatory (LMBO), a migration monitoring station established in 1989 near Last Mountain Lake, Saskatchewan. A small number of sharp-shinned hawks (*Accipiter striatus*, hereafter sharp-shins; Fig. 1) are encountered sporadically during their autumn migration, more often seen near the mist nets than entangled within them. Sightings at LMBO reach a plateau during the last 3 weeks of September; however, records of migrants range from 3 August to 13 October in the surrounding Last Mountain Lake National Wildlife Area (LMLNWA). Little is known about sharp-shin daily and seasonal abundance, the length of their stay, or their behaviour at LMBO.

To answer some of these questions, I conducted a hawk watch from 26 August through 4 October 2004 at the southeast corner of Last Mountain Regional Park to coincide with the daily 6-hour banding period (Fig. 2). LMBO banders provided additional data such as sharp-shin age, travel direction, and time of encounters near the nets (A. Smith, R. Wapple, pers. comm.). Data sets were compared each day to identify birds that may have been seen at both locations.

Figure 2. South end of Last Mountain Regional Park. B = Last Mountain Bird Observatory banding station, W = hawk watch site, C = main campground, G = golf course fairway, H = houses, white arrow = site of most hawk captures. Caragana *hedgerows and their shadows show up as rough-edged lines near the banding station, hawk watch site, and in the campground. Last Mountain Lake is the dark area in the top left corner. Map credit: Lois Vanthuyne adapted an image from Google Earth©.*

Results and Discussion

In total, 444 migrant raptors including turkey vultures (*Cathartes aura*) were recorded during 199 monitoring hours over 37 of 40 potential survey days at the hawk watch site. Stormy weather caused some survey gaps. Some individuals could not be identified to species because of distance or brevity of viewing time. Sharp-shins (n = 183) made up 41% of all birds, occurring on 28 days. Other migrant raptor species included osprey (*Pandion haliaetus*), bald eagle (*Haliaeetus leucocephalus*), northern harrier (*Circus cyaneus*), Cooper's hawk (*Accipiter cooperii*), northern goshawk (*A. gentilis*), broad-winged hawk (*Buteo platypterus*), Swainson's hawk (*B. swainsoni*), red-tailed hawk (*B. jamaicensis*), American kestrel (*Falco sparverius*), and merlin (*F. columbarius*).

Sharp-shins are common annual visitors to the south end of Last Mountain Regional Park but they are undercounted at LMBO. Warning calls by swallow or warbler flocks may be the only indication that this secretive accipiter is in the area. The number of hawk sightings appears to vary inversely with banding activity; that is, a busy bander has little time to watch for hawks and therefore would undercount them.

Sharp-shins were observed by banders on 16 days at LMBO during autumn of 2004. The long-term (1991–2010) median is 14 days. It is assumed that banders

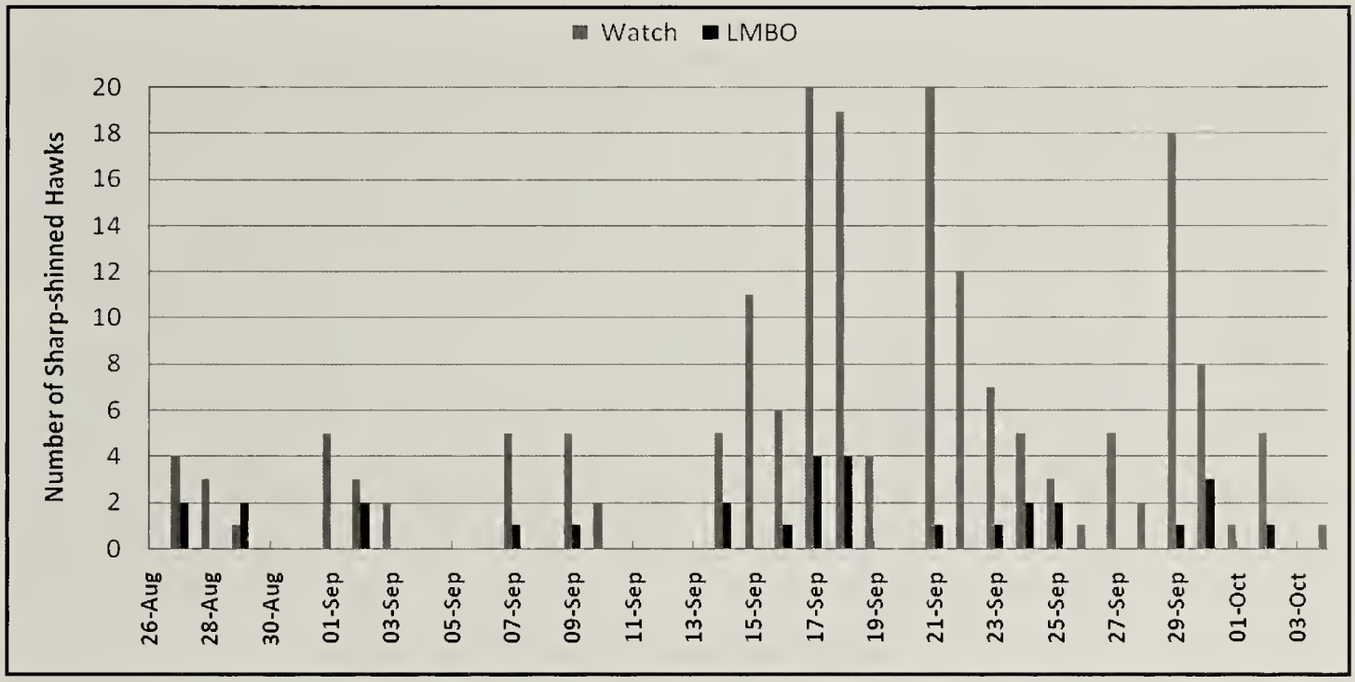


Figure 3. Comparison of daily totals of sharp-shinned hawk sightings at Last Mountain Bird Observatory (LMBO) and at the raptor watch site during 2004.

spend similar amounts of time patrolling the mist net network each year. The hawk watch recorded more sharp-shins and on more days (n = 28) due in part to greater time committed to the task (Fig. 3). The location of the hawk watch allowed monitoring of most hawks in flight that reached the south east end of the park. Dense vegetation favoured by sharp-shins and their prey is clustered on the east side of the park. Sharp-shins are uncommon at any time in the open spaces of the main campground and playing fields close to the lakeshore.

Sightings of sharp-shins show little correlation to the daily abundance of potential prey. Their migration overlaps with the seasonal migration peaks of yellow-rumped warbler (*Dendroica coronata*) and dark-eyed junco (*Junco hyemalis*) through LMBO. These abundant boreal passerines, important prey species for sharp-shins during the breeding season, were less plentiful than usual during fall 2004 migration. LMBO data indicate that yellow-rump and junco seasonal totals overall were at 59% and 84%, respectively, of the long-term median, yet sharp-shin encounters were at typical levels. Anecdotally, sharp-shins are frequently reported on days with few passerines at the park. It is possible that on those days with scarce potential prey an accipiter must keep moving, exposing itself to human eyes instead of relying on an ambush hunting method.

Daily peaks of predator and prey may not coincide due to different migration strategies. Overnight storms force passerines to seek shelter at the park. Cloudy skies at sunset prevent them from using celestial navigation, so some species stay longer. In contrast, accipiters are daytime migrants that can save energy by moving with northerly winds following a cold front. A sharp-shin leaves its summer or natal territory by necessity when its food supply dwindles. It does not cache prey.

The timing of the hawk watch (6 hours, morning to mid-day) documents only some of the raptors because they may migrate at any time of day. Accipiters begin hunting at first light before sunrise. Some successful hunters had obvious bulging crops as they flew past the hawk watch site in early morning. Others were

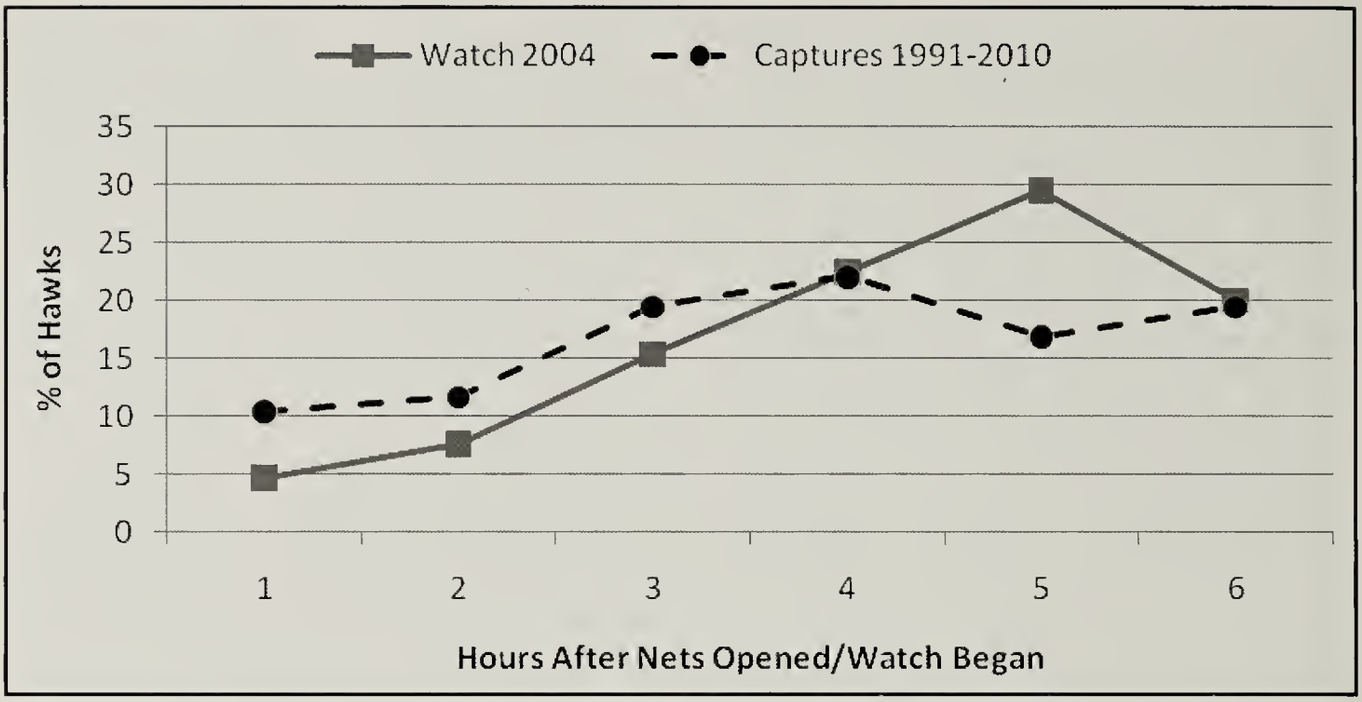


Figure 4. Frequency distribution of sharp-shinned hawk encounters during the 2004 hawk watch and from long-term capture data (n = 77). Time periods are presented as hours after opening the nets because LMBO changes its opening time from 07:00 to 08:00 h CST in late September.

observed still hunting after sunset as they crossed LMLNWA pastures north of the park. Sharp-shin encounters as shown by data from the 2004 hawk watch site or LMBO historical capture records rise through the morning and level off near noon (Fig. 4). I saw a similar pattern at the Windy Point, Alberta, hawk watch site where daily totals exceeded 100 sharp-shins during migration peaks.

This hawk watch counted all visible raptors that passed by at any altitude. LMBO mist nets, with mesh intended for passerine capture, passively sample an unknown proportion of birds including sharp-shins that fly near the ground. Most captured sharp-shins are males; the much larger females can usually climb out. Mist nets at LMBO are 2.4 m tall and 13 m long, with 30-mm nylon mesh. Two nets shaded by dense *Caragana* rows account for most captures (arrow in Fig. 2).

LMBO long-term capture data support the theory that, in general, immature accipiters migrate south in advance of adults. The peak of captures for young birds is in early September. Although the database is small, adult captures rise in late September while those of immature hawks decline. An adult male may migrate later in autumn because it is an experienced hunter that is better able to find scarce food than an immature. It may also remain on the breeding grounds later because it defends a territory. More immatures are captured overall, in part, because in most years they outnumber adults.

The route of arrival at the park by accipiters varies. Some sharp-shins darted low through narrow channels between bulrush beds in the LMLNWA marshes while others used powered flight at 5 to 15 m to cross pastures and hayfields. Once at the park, sharp-shins hunted for avian prey using two techniques – by ambush or by patrol.

After watching a potential prey bird, a hawk would leave its perch abruptly, using shaded cover in its rapid approach. If the target is a warbler already in a

mist net, this "perch and pounce" attack means that some hawks crash into the nets. Most are able to escape from the net within seconds and the warbler is unharmed. Usually one crash is enough. Only one sharp-shin has been recaptured on consecutive days in the park.

A trolling technique similar to that of northern harrier was observed at the park. A sharp-shin would fly slowly along *Caragana* rows bordering the golf course fairways where a naïve bird might stray from cover. No captures were observed.

Sharp-shins also visited bird-feeding stations at the nearby cottages. Prey included voles or mice attracted by spilled seeds. Feather piles from warblers or sparrows are found usually in early morning at LMBO, and this predation is usually attributed to sharp-shins. Larger species such as robins are at greater risk from Cooper's hawk.

Most sharp-shins that reached the hawk watch site beside the park boundary were flying at or below hedgerow height. A few maintained that altitude as they continued across the adjoining pasture while looking downward into the grass. Most hawks at the boundary fence, however, climbed in a tight spiral for up to 30 seconds, and resumed the flap-flap-flap-and-glide flight pattern that identifies the accipiter group. Sharp-shins that climbed above tree height did not return to the park. Their flight plan was southeast, except when deflected by strong northeasterly winds. Many individuals appear to travel through the LMBO area in less than 2 minutes.

In conclusion, migrant sharp-shins are more common at the regional park than previous anecdotal evidence suggested. The park attracts small boreal bird species that are typical prey items for sharp-shins. It is important as a feeding area for migrant sharp-shinned hawks but not for other raptors, such as Cooper's hawk. The total number of raptors seen in 2004 is small compared to established hawk watch sites because the park lacks geographical features that might attract most migrant raptors. Foothill ridges in southwestern Alberta or the Pembina valley in Manitoba, respectively, create wind waves or uplifts used by migrant hawks to save energy.

Acknowledgements

I am grateful to the reviewer whose thoughtful suggestions greatly improved the manuscript. Alan Smith posed the original questions about sightings versus sharp-shin presence and provided historical data. Lois Vanthuyne created the map.

We cannot command nature except by obeying her.
- Francis Bacon

UPDATE ON THE RANGE AND DISTRIBUTION OF BLUE-SPOTTED SALAMANDERS IN MANITOBA

Shauna Hewson[1], William G. Watkins[2]

[1]2115-991 Markham Road, Winnipeg Manitoba, R3T 5K1; E-mail: <shauna.hewson@live.ca>

[2]Manitoba Conservation, Winnipeg, MB R3J 3W3; E-mail: <william.watkins@gov.mb.ca>

Introduction

The blue-spotted salamander (*Ambystoma laterale*) is one of Manitoba's most secretive amphibians. This trait has prevented most researchers from collecting comprehensive data about its population numbers, range, and distribution in Manitoba's boreal forests. Since 1982, the most informative range data available have come from Preston's book on the amphibians and reptiles of Manitoba.[1] Preston proposed a hypothetical range for this species that includes Manitoba's southeast corner, extends west to the Brokenhead River and north partway into the Interlake region. Several specimens were collected at Riverton during that time, which served to delineate the northern range limit of the species.[1]

The blue-spotted salamander is black to light grey in colour, with small blue spots on its ventral surface, lateral surface, and tail.[1,2] This spot pattern is highly variable, and spot colour can range from bright blue to very pale blue or almost white.[1,2] The blue-spotted salamander has several qualities that make it difficult to survey. Its small size (average 130 mm in length) allows it to utilize any number of small animal burrows, crevices inside rotten logs, or piles of rotting leaf debris on the forest floor.[1,2] Adults and juveniles avoid sunlight, and thus are almost never seen out in the open during daylight hours.[1,2] They feed on groups of arthropods and other small invertebrates normally found in these microhabitats.[1,2] Salamander surveys are very labour intensive because even a small survey area in a boreal forest could contain hundreds of possible niches for adults to hide in. It seems that their terrestrial movement is infrequent, so that even above-ground traps or cover boards have limited success for surveys.[3]

During the summer of 2008, Manitoba Conservation updated provincial status ranks for all amphibians and reptiles in Manitoba. Status ranking involves evaluating all information available for each species to assign a status rank that accurately reflects the scope of current knowledge on species range and abundance.[4] Assigning a rank to the blue-spotted salamander was difficult due to the minimal number of valid sightings reported since 1982. Local naturalists suggested that these animals should be classified as abundant, although a decision to do so would have to be based mostly on anecdotal reports and limited sightings. As a compromise, blue-spotted salamanders were tentatively ranked as 'S3/S4' pending

completion of the surveys described in this paper. A rank of S3/S4 suggests that the species is considered widespread, abundant, and apparently secure, but there is some uncertainty or lack of data to support this assumption.[4]

Presence/absence surveys are generally used to record a measure of proportional occupancy in a given area.[5] For the purpose of this study, the method was utilized to examine Preston's proposed range for the species in Manitoba.[1] Two potential weaknesses of this survey style have been identified.[5] First, it is not a reliable indicator of abundance because presence/absence surveys can over- or under-represent a population. This disguises population declines and overlooks population growth. Second, the chance of species detection can fluctuate due to temporal and spatial dynamics of a population, making survey results ambiguous[5] (see also reference 6). Our focus was on finding new sites, rather than estimating abundance, in order to avoid some of these shortcomings.

Methods

Surveys for blue-spotted salamanders began in May and were completed in July 2009. Survey sites were chosen based on current Conservation Data Centre (CDC) records or Manitoba Museum records. All sites of interest were located or situated in the southeast corner of the province, east of Highway 59 and north to the limit of Provincial Road 304 near Bissett. The first surveys examined known or previously reported but unconfirmed locations to allow surveyors to develop a habitat and species search image. Later surveys examined new locations. All new site occurrences discovered were mapped in the CDC's GIS database.

Two survey methods were used to look for blue-spotted salamanders. In spring and early summer, aquatic surveys were conducted to look for eggs and larvae. Later in the summer, terrestrial surveys were used to locate adult specimens. In total, 39 sites were surveyed.

From 1 May to 30 June, aquatic searches were performed at Star Lake in Whiteshell Provincial Park, Grand Beach Provincial Park, Sandilands Provincial Forest, and East Braintree (just west of Whiteshell Provincial Park along Highway 1). An underwater viewer facilitated examination of benthic areas in ponds, vernal pools (temporary woodland pools created by melting snow and spring rains), and ditches. The 28×28 cm viewer allowed surveyors to walk slowly while examining the benthos along 28 cm wide transects across the bottom of the water body. When multiple surveyors were present, one observer used the viewer while others searched the benthos without visual aid. Dip nets were used to catch larvae and confirm their identity. We discovered that the most useful technique involved placing the open dip net 30 cm ahead of the organism and then shuffling toward it so that it swam into the net and could be examined.

Terrestrial surveys were conducted following a previously established protocol.[7] Survey locations included sites at Grand Beach, Agassiz Provincial Forest, Patricia Beach, Brokenhead, Gull Lake, Whiteshell Provincial Park, and Nopiming Provincial Park. Habitat was deemed suitable if it contained mixed forest, deciduous brush areas, fallen logs, or any natural or man-made object that might provide a covered microhabitat for salamanders. An area with an approximate radius of 100 m was randomly delineated within suitable habitat, and timed searches of 20 minutes duration were performed by two surveyors within this area. Surveyors worked from the interior to the periphery of the study area. On each transect, we turned over logs, boards, and other man-made objects

such as buckets or tin cans. If the edge of the site was reached before the allotted 20 minutes had expired, the surveyor would continue searching, moving back to the interior until time ran out. Variability in the amount of downed material would dictate the total area surveyed, but the number of hiding sites searched in 20 minutes was relatively consistent between sites.

Results and Discussion

Aquatic surveys were unsuccessful in locating salamander eggs or larvae. No eggs were found during the course of the study, and larvae were seen at only one site near Star Lake. The underwater viewer greatly improved our ability to search the benthos, but, despite the most careful search techniques, salamander eggs are easily missed due to their transparent appearance (which camouflages well in benthic sludge) and their typically small clusters of three or four eggs. Larvae become easier to see several weeks after hatching as their size and range of activity increases on the pond bottom. The first larva was spotted in a borrow pit pond near Star Lake in early June and measured ~5 mm long. The second larva was found in the same pond in late June and measured ca. 15 mm long (Fig. 1).

Terrestrial surveys were far more successful than the aquatic surveys in finding new locations for blue-spotted salamanders. We found adult blue-spotted salamanders at four new locations: Werner Lake Road, Gull Lake, and two locations around Flanders Lake. Additional sightings were confirmed from sources in Beausejour, Grand Beach, Moose Lake, Pelican Harbour, Pinawa, Rennie, and Washow Bay.

Figure 1. Larval blue-spotted salamander near Star Lake, Manitoba, in late June 2009. *Doug Collicut*

In total, 19 sites with blue-spotted salamander populations were mapped, including the pond where larvae were discovered, three sites catalogued at the Manitoba Museum, the new locations cited above, and 11 sites contributed by the general public or Manitoba Conservation employees that were confirmed by photographs or site visits (Fig. 2).

The adult specimens found on Werner Lake Road and around Flanders Lake were sitting in substrate containing pine needles. This seemed to contradict the popular notion that salamanders avoid areas with coniferous trees. The largest group of adults (n = 7) counted at one location were nestled into a pile of damp, coarse gravel covered with a tarpaulin. The adults found near Gull Lake were lying in a mixed substrate containing mostly sandy soil and gravel, a substrate that agrees with the habitat previously suggested for this species.[1]

We discovered that sites with human activity were hotspots for adult salamanders since cottager activity provided favourable habitat. Loose plywood, shingles, and cardboard piles were frequently seen with one to seven salamanders congregated underneath. It was noted that these garbage piles were often covered with a tarpaulin, making them warm and very moist, supporting large amounts of invertebrate life. This affinity for cast-off debris may prove useful for establishing new locations for blue-spotted salamanders in the future. Much of their range contains cottage developments on lake shores

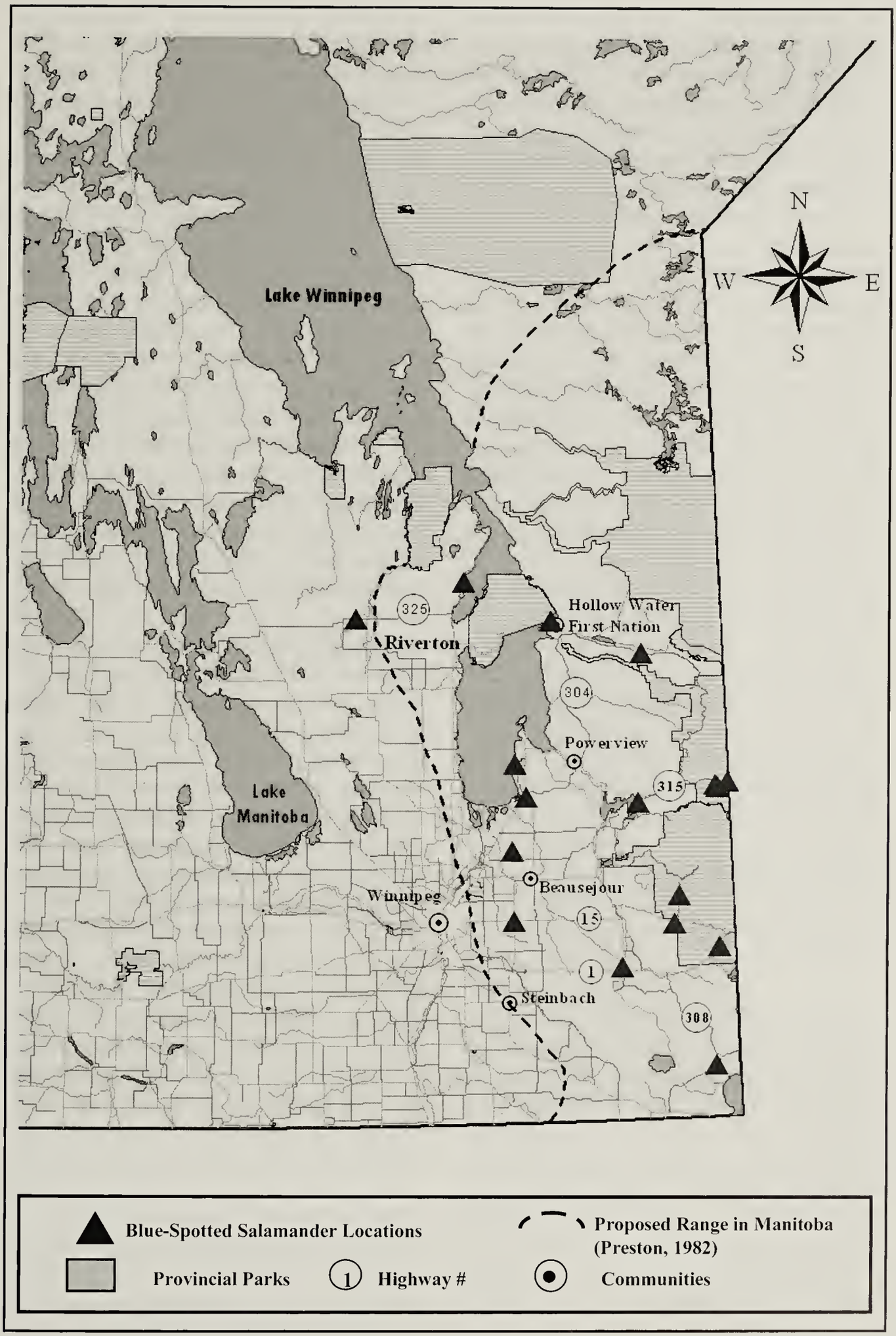


Figure 2. Blue-spotted salamander locations in southeastern Manitoba.

with these artificial salamander habitats. We believe that future presence/absence surveys in Nopiming Provincial Park would contribute data points to fill out the northern portion of Preston's range map, and that the observations described above provide an easy search image to use when surveying around lake areas.[1]

Promoting Awareness of Manitoba's Herpetofauna

During the summer of 2009, Manitoba Parks and Natural Areas Branch invited Winnipeg biologist Doug Collicutt and one of the authors (S. H.) to give presentations on the amphibians and reptiles of Manitoba to park visitors in Whiteshell Provincial Park. On 3 July, the first of two presentations was held at the Falcon Lake Campground Amphitheatre, attracting 157 people. A Powerpoint presentation was used to discuss the ecology and conservation status of Manitoba species and the rationale for monitoring and conserving herpetofauna. The audience was also shown how to identify frogs by their appearance and calls. The final part of the presentation was an informal question and answer period that involved a live demonstration of captive specimens. Audience members were able to view and discuss 14 species, and to review the identification points from the formal presentation.

On 14 August, a more hands-on approach was used at Brereton Lake Campground. Live specimens were circulated around the audience and spectators were invited to participate in a discussion about the animals. Topics discussed included physical traits, frog call identification, basic ecology of the organisms presented, and basic safety and handling techniques for observing reptiles and amphibians.

These presentations served two purposes: first, they were designed to make Manitobans aware of all species of herpetofauna within the province. This was especially important for species like the blue-spotted salamander, because its reclusive lifestyle makes it unknown to most people. Second, we were able to encourage Manitobans to participate in developing an on-line reptile/amphibian atlas for the province on Doug Collicutt's NatureNorth website. NatureNorth.com (http://www.naturenorth.com/) is a Manitoba-based internet magazine focusing on Manitoba's natural history. The atlas project will involve establishing a citizen-science network to report sightings of all reptile and amphibian species leading to a better understanding of the range and status of these species in Manitoba. Eventually, individuals will be able to post observations or data related to amphibians and reptiles directly to the website.

Presenting the public with an opportunity to learn about Manitoba's amphibian and reptile species is important. Education empowers people to share their newly acquired knowledge with others and increases public awareness for species of concern. In turn, this awareness serves to foster a natural curiosity in people as they gain a new understanding of natural ecosystems and become interested in spotting these creatures themselves. Also, awareness and interest in species facilitates the development of a network of knowledgeable observers able to accurately report sightings. In the weeks following our seminars, we learned of the studies being conducted on blue-spotted salamanders in Pinawa by Peter Taylor (this issue) and were able to share observations with him. Members of the public also sent in several sightings for blue-spotted salamander in regions that we were not able to cover in our 2009 surveys. One of these sightings came from Washow Bay and is now the most northern range sighting known for this species (see Fig. 2).

Conclusion

Blue-spotted salamander surveys in the summer of 2009 yielded five new location records for the species (one pond with larvae and four terrestrial sites with adults) out of 39 locations searched. In contrast, soliciting observations from the public and Manitoba Conservation staff resulted in 11 new records. Several of the newly located sites were adjacent to cottage subdivisions where salamanders were found to be utilizing human refuse piles for shelter and food. Blue-spotted salamanders may be abundant around lakes within Whiteshell and Nopiming Provincial Park and the Interlake Region, and more effort to provide information on the species to cottagers may be rewarded with additional observations. Given the secretive nature of the species, developing a network of knowledgeable volunteer observers that can collectively examine thousands of sites may be the best approach to further define the range of blue-spotted salamanders in Manitoba.

Although Preston's 1982 range map for blue-spotted salamanders was based on a relatively small number of observations, only one of our new site locations lies outside of his proposed range for the species.[1] However, we were unable to survey sites north of Nopiming Provincial Park to test the validity of the range boundary in the north east. We hope that within the next few years, more data will be collected to further define the range of the species in Manitoba.

Blue-spotted salamanders appear to be secure within their range in Manitoba but, with the absence of any clear understanding of threats to the species, a lack of population data, and the uncertainty regarding the extent of the species range east of Lake Winnipeg, conservation status must remain S3/S4 at this time.

Acknowledgements

We thank Diane Kunec, Garret Elias, Mahesh Kalia, Chris Friesen, and Christian Artuso for their enthusiastic participation in our surveys, and Jaimee Dupont for help with mapping location data. We also thank Manitoba Parks and Natural Areas Branch for the opportunity to present information on Manitoba's amphibians and reptiles to park visitors. We are grateful to Peter Taylor for helpful discussions regarding our observations. Finally, we thank Doug Collicut for his enthusiastic support of the project, his participation on surveys, and his guidance on field techniques, and for sharing opportunities to reach out to the public. We also extend our thanks to Doug for allowing us to include his blue-spotted salamander larva photo in this article.

1. Preston WB (1982) The Amphibians and Reptiles of Manitoba. Manitoba Museum of Man and Nature, Winnipeg, MB.

2. Cook FR (1984) Introduction to Canadian Amphibians and Reptiles. National Museum of Natural Sciences (Canada), Ottawa, ON.

3. Regosin JV, Windmiller BS, Homan RN, Reed JM (2005) Terrestrial habitat use by pool-breeding amphibians. *Journal of Wildlife Management* 69(4):1481-1493.

4. Manitoba Conservation Data Centre (2004) Species Ranking. Manitoba Conservation, Winnipeg.

5. Milner-Gulland EJ, Rowcliffe JM (2007) Conservation and Sustainable use: a Handbook of Techniques. Oxford University Press, Oxford.

6. De Solla SR, Shirose LJ, Fernie KJ, Barrett GC, Brousseau CS, Bishop CA (2005) Effect of sampling effort and species detectability on volunteer based anuran monitoring programs. *Biological Conservation* 121(4):585-594.

7. Zorn P, Blazeski V, Craig B (2004) Joint EMAN/Parks Canada National Monitoring Protocol for Plethodontid Salamanders. Version 1, July. Environment Canada.

SEASONAL MOVEMENTS OF BLUE-SPOTTED SALAMANDERS AT PINAWA, MANITOBA

Peter Taylor

P.O. Box 597, Pinawa, MB, R0E 1L0, E-mail: <taylorp@granite.mb.ca>

The blue-spotted salamander (*Ambystoma laterale*) is an inconspicuous, forest-dwelling mole salamander (family Ambystomatidae) that reaches its northwest range limit in southeastern Manitoba.[1,2] Anecdotal reports of salamanders breeding in a garden pond in Pinawa, MB, and sometimes appearing on streets and in window wells and swimming pools, prompted me to search Pinawa streets for them on rainy nights. Two initial 4-km surveys on the night of 29-30 September 2008 turned up a total of 11 salamanders, demonstrating that this approach can be productive. I therefore conducted similar surveys during the remainder of fall 2008, from spring to fall 2009, and in spring, late summer, and fall 2010. The main aim was to learn about the seasonal timing and favourable conditions for salamander movements. This study coincided with a 2009 survey of the blue-spotted salamander's distribution and conservation status in Manitoba, as described by Hewson & Watkins (this issue). It also complements a previous review of seasonal activity periods (mostly calling dates and times) for frogs and toads in the Pinawa area.[3]

Study Area

Pinawa (50.18° N, 95.88° W) is located in the boreal forest of southeastern Manitoba, adjoining Whiteshell Provincial Park, well within the range of the blue-spotted salamander.[1,2] The town site (current population, ca. 1500) is a mosaic of residential, public, and commercial developments, rocky outcrops, and forest fragments. Cameron Woods is a partly developed, 28-ha block of forest, bounded on the north by Provincial Road 211 and on the south, east, and west by Pinawa streets. The mixed-wood habitat resembles much of the continuous forest surrounding the town, as described recently by Hughes.[4] It is dominated by trembling aspen, balsam poplar, white birch, balsam fir, and white spruce. Black spruce and black ash occur in moist, lower-lying areas, jack pine on rocky outcrops, and several other tree species are less common or more locally distributed.

My surveys focused mainly on two of the streets bounding Cameron Woods (Cameron Road and a portion of Vanier Avenue) and two residential streets (Devonshire Avenue and Landsdowne Avenue) that radiate away from Cameron Woods. Some of the back yards on the latter streets adjoin some smaller forest fragments. Other streets and rights of way, mostly in more densely developed parts of the town site, were surveyed less frequently. Most Pinawa streets are 8 or 10 m wide and paved with concrete rather than asphalt.

Methods

Blue-spotted salamanders emerge in early spring and are active above ground at night, especially during wet weather.[1,2,5] Surveys were therefore conducted between March and early November, mostly between 21:00 h and midnight on mild, wet nights with light winds; the main parameters are summarized in Table 1.

Table 1. Main survey parameters (2008, 2009, and 2010 combined; 75 surveys).

	Minimum	Average	Maximum	Total
Date (all surveys)	10 March	---	10 November	---
Date (salamanders detected)	12 April	---	2 November	---
Start (hours after sunset)	1.0	3.1	7.6	---
Finish (hours before sunrise)	2.9	7.1	11.2	---
Duration (hours : minutes)	0 : 35	0 : 48	1 : 30	60 : 55
Distance (km)	2.4	3.2	4.7	239.3
Live salamanders detected	0	2.44	20	183
Dead salamanders detected	0	0.15	2	11

The most frequent route was a 3-km return trip along most of Devonshire Avenue and Cameron Road plus short portions of other streets. I used street lighting, occasionally supplemented with a flashlight, to detect salamanders.

Moisture conditions were noted, using the following six-point scale: 1, moderate to heavy rain; 2, light rain; 3 to 6, not raining but streets were >90%, 50–90%, 10–50%, or <10% wet. Air temperature and approximate wind speed, the locations of salamanders, and their behaviour when approached or handled were also noted.

The total length (TL) of each salamander found in 2009 and 2010 was measured or estimated with a precision of 0.2 to 1.0 cm. Snout-to-vent length (SVL) measurement was considered too difficult and intrusive; SVL is about 55–60% of TL in this species.[6]

Results and Discussion

Seven surveys were conducted between 29 September and 25 October 2008, 46 between 24 March and 10 November 2009, five between 10 March and 4 May 2010, and 17 between 14 August and 10 November 2010. On three occasions,

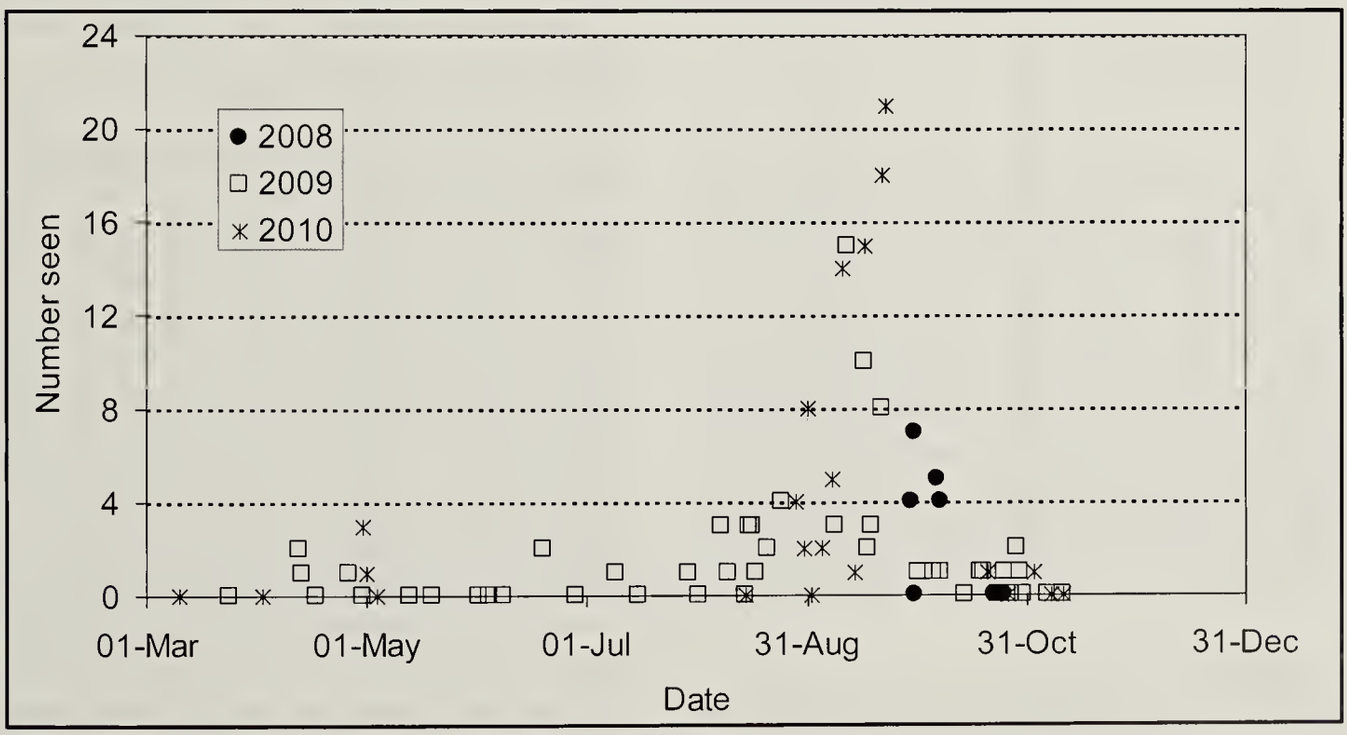


Figure 1. Numbers of blue-spotted salamanders detected during all surveys in 2008, 2009, and 2010.

Figure 2. Blue-spotted salamander at Pinawa, Manitoba, 30 September 2008, showing head-up posture. Note the four-toed forefeet and five-toed hindfeet. Peter Taylor

two surveys were done on the same night. Total duration, total distance, and overall results are included in Table 1, and the results of all 75 surveys are shown in Fig. 1. On average, 2.44 live and 0.15 dead salamanders (recent road kills) were detected per survey, including 30 counts of zero. Peak counts were 15 salamanders on 11 September 2009 and 14 to 21 on four surveys between 10 and 22 September 2010. Counts of live and dead salamanders were combined for the data analysis.

All of the salamanders observed were on paved surfaces and not in their normal forest-floor habitat. The surveys therefore sampled actively migrating or dispersing individuals, but numbers and size distributions do not represent the whole population. Several individuals were photographed (see Fig. 2 and front cover), and two road-killed specimens were salvaged and donated to The Manitoba Museum.

Seasonal Occurrence

The data compiled in Fig. 1 show the following seasonal features: a small spring activity peak between mid-April and early May, a lull between early May and early June, limited activity between June and mid-August, and a large peak between late August and early October, with further limited activity persisting beyond early snowstorms almost to freeze-up. Significant sequences included six consecutive zero counts between 30 April and 8 June 2009, and 14 consecutive counts of one or more (total 58) between 15 August and 7 October 2009. The 15 highest counts (four or more individuals) were all between 24 August and 7 October.

The timing of the spring peak between mid-April and early May was much as expected from other reports for Manitoba and central Ontario, but numbers were low.[1,5,7,8] Blue-spotted salamanders have been described as explosive breeders that arrive at breeding pools in concentrated movements.[2,7,8] It is possible that brief, concentrated movements from wintering sites to breeding pools passed undetected, or that the main spring migration paths in Pinawa do not cross the survey routes. There was patchy snow cover on the earliest date that salamanders were detected, 12 April 2009, which is also consistent with other reports.[1,7,8] This

record preceded the first calling individual wood frogs (*Lithobates sylvatica*) and boreal chorus frogs (*Pseudacris maculata*) by 2 days, the first choruses of those species by 10 days, and the first observed movement of northern leopard frogs (*L. pipiens*) by 18 days.

In an intensive study in Massachusetts, Regosin et al. also noted a summer lull in above-ground movement by blue-spotted salamanders between the breeding season and the post-transformation dispersal of immatures.[9] However, those authors detected much smaller numbers in fall than spring, which is the opposite of the findings reported here (Fig. 1). This difference may be related to their systematic use of several detection techniques with special attention to the vicinity of breeding ponds, whereas my study was more opportunistic.

Weather Conditions

Amphibian numbers and activity can vary greatly with prevailing weather conditions, especially moisture levels. To assist comparison with other studies, it is therefore important to mention the unusual weather in 2009 and 2010. Both years were exceptionally wet; the only prolonged dry spells were in September 2009, April 2010, and October 2010. Spring and summer 2009 were also unusually cool, with foliage development, insect emergence, and bird migration all about 2 weeks later than normal; in contrast, spring 2010 arrived unusually early. These conditions likely influenced the timing of salamander emergence, breeding, metamorphosis, and dispersal.

The onset of late-summer salamander dispersal in 2009 followed the year's third highest one-day rainfall (45.8 mm) on 15 August. Peak numbers were detected shortly after further heavy rains, 58.4 mm on 8 September and 32.0 mm on 11 September, punctuating an otherwise dry, warm month. The heavy rain on 15 August also triggered a major dispersal of immature northern leopard frogs, with massive highway mortality, just west of Pinawa. While leopard frogs sometimes appear on roads within minutes of the start of a downpour, the largest numbers of salamanders were typically found immediately after but not during prolonged rains (see below).

Survey results were compiled in three classes (0, 1–2, and ≥3 salamanders seen) and plotted against temperature and moisture conditions in Fig. 3. This relatively complex figure can be interpreted as follows. High counts (>3 salamanders) were recorded mainly on wet streets shortly after substantial rainfall (moisture code 3), less often during rain (codes 1 and 2), and sometimes on dry or partly wetted streets (codes 4 to 6). Whenever large numbers were observed on dry streets, the surrounding wooded habitat was still saturated after previous rains. Low counts (1 or 2 salamanders) were recorded mainly under cool conditions (4–10°C), but also at warm temperatures outside the peak dispersal period (see Fig. 1). Zero counts in Fig. 3 are widely scattered, but with some clustering towards the wettest conditions and lowest temperatures. The observed lower threshold air temperature for salamander movements is about 5°C, though one was observed making good progress across a street at 4°C on 20 October 2010. This low threshold, the early onset of activity in spring, and continuing movements well into the fall are all consistent with the ability of blue-spotted salamanders to remain active at surprisingly low temperatures, although unlike some northern frogs, they cannot survive freezing.[5,10]

Size

TLs of salamanders found in this study varied from 5 to 13 cm. Most field guides give maximum TL in the 12–14 cm range

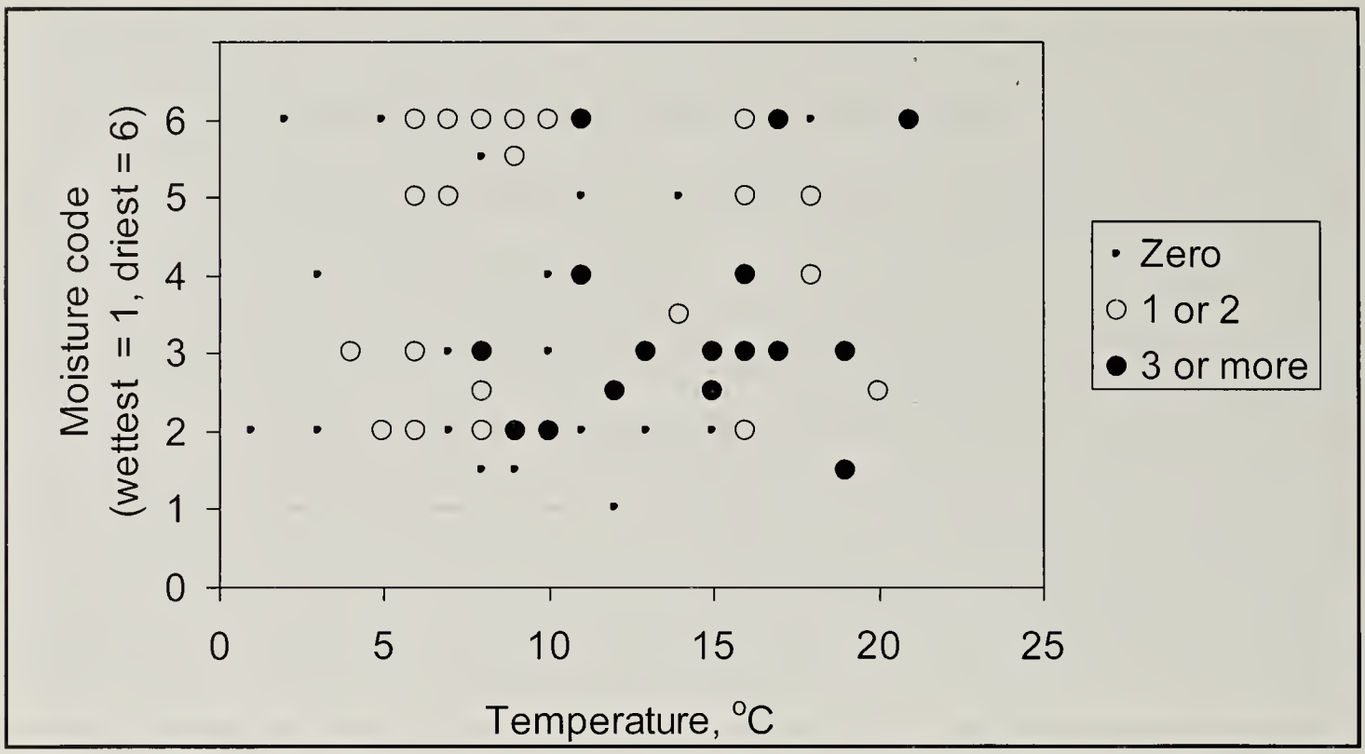


Figure 3. All survey results (numbers of salamanders found), plotted against air temperature and moisture conditions.

for non-hybrid blue-spotted salamanders. In southern parts of their range, blue-spotted salamanders frequently hybridize with related species, especially the larger Jefferson salamander (*Ambystoma jeffersonianum*), but the hybrid zone does not extend to Manitoba.[1,2,6,7] Hulse et al. reported TL values for newly transformed blue-spotted salamanders of 5.0 cm in Maine and 6.5 cm in Nova Scotia.[6] Size at transformation, however, may vary with food availability and water conditions at the breeding pond.[6,12]

I divided TL measurements for 2009 and 2010 into 9 evenly spaced categories from 5.0 ± 0.5 to 13.0 ± 0.5 cm. Estimated lengths on the 0.5 cm marks were alternately rounded up and down, so as not to bias the data distribution. Fig. 4 compares the size distribution of salamanders seen during 2009, (a) up to and including 15 August, and (b) on and after 16 August. Sightings up to 15 August, though scarce, included mainly large individuals (9 of 14, or 64%, were 8.5 cm or longer). These presumably included fully grown adults, the largest being two 12-cm-long individuals observed on 12 April 2009. Salamanders seen on and after 16 August were mainly small (49 of 60, or 81%, were shorter than 8.5 cm), consistent with the dispersal of immature animals. Data for the peak period in 2010 confirmed the earlier movement of large size classes, as shown in Table 2. The percentage of individuals longer than 8.5 cm declined from 75% on 28 August – 4 September to 10% on 21–22 September.

Comparison of size distribution for the peak activity periods in 2009 and 2010 (Fig. 5) showed a slight shift towards larger animals in 2010. While small animals were still in the majority, the peak shifted from the 6-cm to the 7-cm size class, and there was higher representation of large and intermediate size classes. Combined with the relatively large numbers found in 2010, this suggests good productivity and growth of juveniles, as well as good yearling and adult survival, in the prevailing wet conditions. The sample sizes are small, however, and much more data would be needed before such variations could be verified and interpreted with any confidence.

Table 2. Summary of salamander measurements, 2010. TL: total length.

	Aug 28 to Sept 4	Sept 10	Sept 16	Sept 21	Sept 22
N (total)	16	14	15	18	21
N (TL > 8.5 cm)	12	5	3	3	1
% (TL > 8.5 cm)	75.0	35.7	20.0	16.7	4.8
Minimum TL	6.0	6.0	6.0	5.4	6.0
Median TL	9.3	7.0	7.2	7.2	7.1
Maximum TL	12.0	13.0	10.0	9.8	11.0

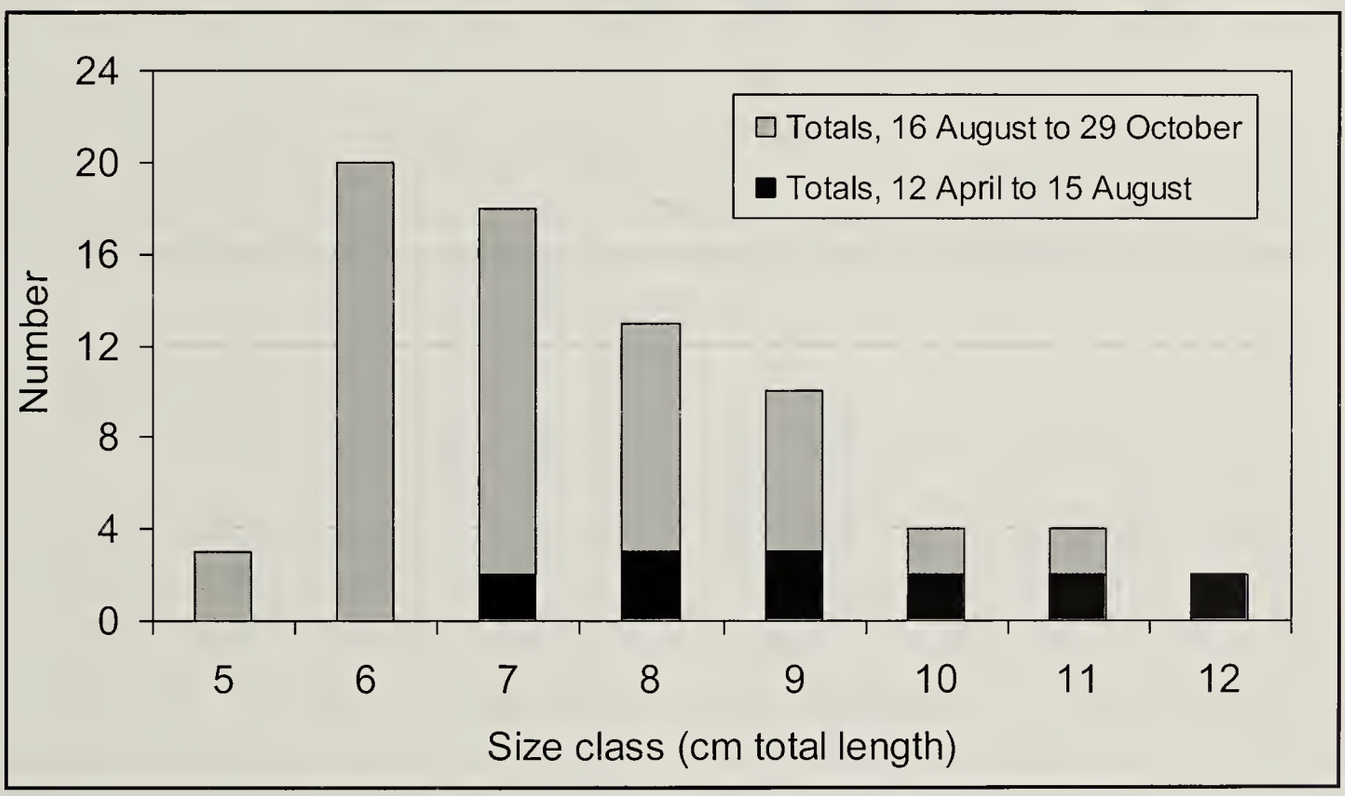


Figure 4. Total lengths of salamanders found between 12 April and 15 August 2009, and between 16 August and 29 October 2009.

This species is reported to take 2 years to reach sexual maturity.[2] It was not possible to identify yearlings with any confidence in this study, except for two overwintering individuals measuring 6.5 and 7.0 cm on 26 April 2009 and 1 May 2010, respectively. Spring sample sizes were too small for detailed analysis.

Habitat

Blue-spotted salamanders use a variety of deciduous and mixed-wood forest habitats, so long as vernal pools (formed by snow melt) or fish-free ponds are available for breeding.[1,2,5,11] They are reported to be relatively tolerant of selective logging and low-density residential development, although local populations may be threatened by clear cutting and road building near breeding ponds.[11] Various studies have indicated that this species disperses at least 150 to 200 m from breeding pools.[2,9] In the Pinawa surveys reported here, salamanders were found within an irregularly shaped area about 0.9 km from north to south and 1.3 km from east to west, but they were not uniformly distributed within this area.

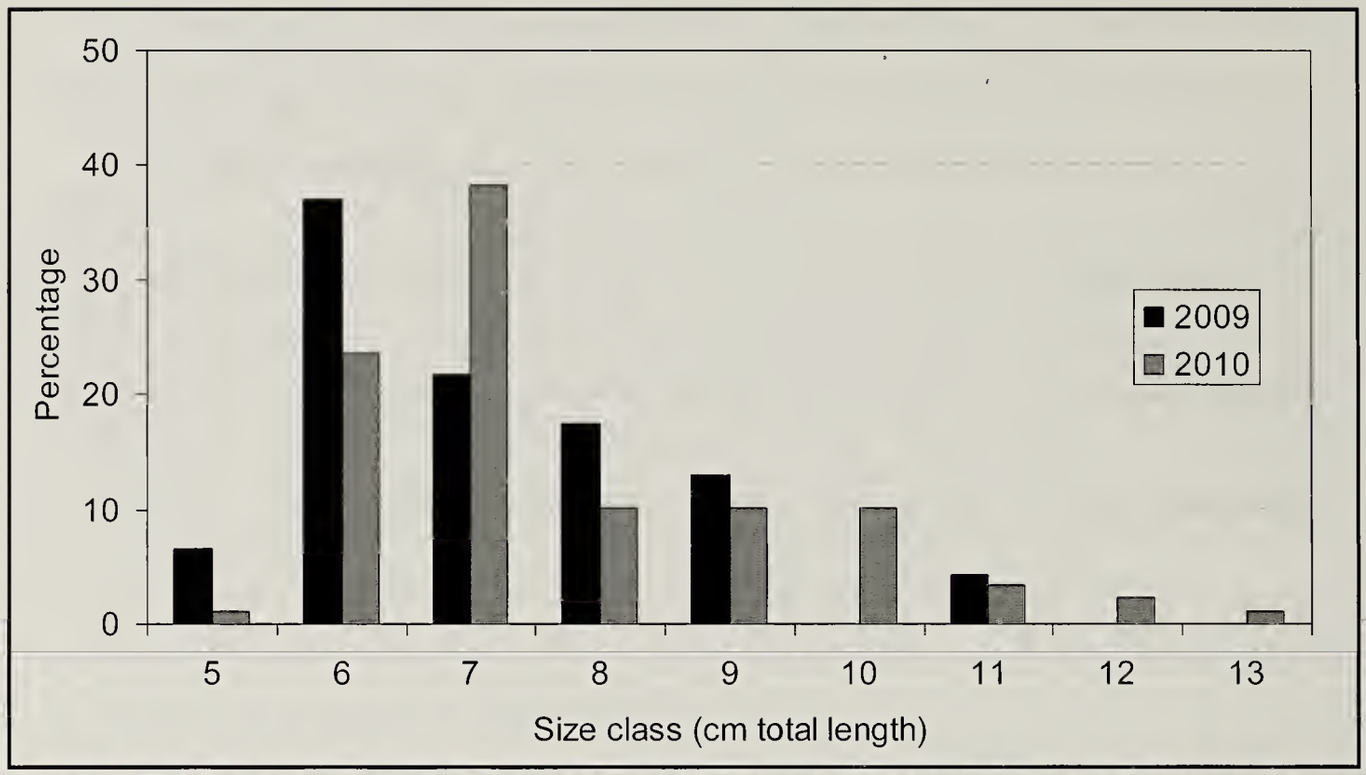


Figure 5. Size distributions (percentages) of salamanders detected during seven surveys between 24 August and 21 September 2009 (N = 46 salamanders) and ten surveys between 28 August and 22 September 2010 (N = 90).

I compiled the locations where 72 individual salamanders (at least three per survey) were found on the 13 highest counts in 2008 and 2009. Data from the 2010 surveys were excluded because they were deliberately focused on known "hot spots" and expected peak activity periods. Forest fragmentation and development density are difficult to quantify for the different survey routes, because of the complex street layout and habitat mosaic, but streets were broadly classified as low, medium, and high development density (categories A, B, and C in Table 3). The results show that salamander numbers were highest in or near Cameron Woods (category A), and lowest in areas of high development density and minimal forest cover (category C). The numbers of salamanders per kilometre for the three categories are significantly different from those expected for a random distribution throughout the survey area (chi-squared test, $\chi^2 = 40.99$, df = 2, $p < 0.1$). Furthermore, all four salamanders on category C survey routes were located near isolated forest fragments, which in retrospect would be better classified as category B sub-areas.

Salamander distribution was also non-random along a given street. For example, the largest concentrations in 2010—as many as six salamanders within a 10-m radius—were found in a portion of Cameron Road near a low-lying ash stand that is suspected to be an important breeding area.

Behaviour and Road Mortality

Nearly all salamanders were stationary when first observed on the street surface; the straight body and tail, with head slightly raised, provided a distinctive search image (Fig. 2). Five salamanders were encountered walking across streets with a characteristic, side-to-side, undulating (standing wave) motion that is constrained by their sprawling posture.[12,13] Reactions of individual salamanders to touching and handling were generally most lively in mild, wet conditions and most lethargic in cool, dry conditions. When sufficient water was present on the road, lively individuals

Table 3. Analysis of the 13 highest salamander counts in 2008 and 2009 by location. See text for a description of categories A, B, and C.

Location	Category	Number	Distance, km	Number per km	Description
Cameron Rd.	A	42	13.1	3.20	Extensive woods with discontinuous residential development on both sides of the street.
Landsdowne Ave.	B	6	3.0	1.97	Perpendicular to Cameron Woods with continuous residential development on both sides, backing onto smaller forest fragments.
Vanier Ave.	B	7	4.3	1.63	Adjoining Cameron Woods; mostly open public reserve and residential development on the other side.
Devonshire Ave.	B	13	9.9	1.31	Similar to Landsdowne Ave. but extending farther from Cameron Woods.
Elsewhere in Pinawa	C	4	16.2	0.25	Mostly higher-density development with few forest fragments.

escaped with a rapidly undulating (propulsive wave) motion, sometimes called anguilliform (eel-like) locomotion.

Salamanders adopt a wide variety of defensive postures, often coupled with the secretion of noxious substances, to deter potential predators.[14] Collicutt noted that he was unable to elicit such a response in blue-spotted salamanders.[5] Only about six small individuals of the 183 live salamanders I encountered adopted a tail-raised posture when approached.

Most of the salamanders that did not escape to the roadside were transferred by hand to the nearest vegetative cover. This brief handling seemed preferable to leaving them exposed to traffic or possible disorientation and dehydration. The low number of road kills and obvious injuries (combined, about 10% of the salamanders found) is encouraging, but dead salamanders are often badly damaged and difficult to detect.

Conclusions

Blue-spotted salamanders proved to be surprisingly easy to find under street lighting in areas of low-density housing adjoining large fragments of mixed boreal forest. The peak late-summer movement involved dispersal of both adult and immature individuals, with larger animals moving mainly in the early phase of this peak; spring movements were barely detected. Although obviously limited to areas with suitable streets and lighting, the methods used in this survey may be helpful in detecting salamanders at other

forest communities, and may complement the diurnal searching methods described by Hewson & Watkins (this issue).

While the Cameron Woods forest fragment appeared to be key habitat in the current study, it is similar to much of the continuous boreal forest surrounding Pinawa. Some local habitat loss to housing development, though regrettable, is therefore probably not significant for conservation of blue-spotted salamanders at the regional or provincial level. The species' status as a member of the Manitoba fauna, though geographically limited, appears to be relatively secure (Hewson & Watkins, this issue).

Acknowledgements

I thank Nancy Bremner for the initial observations that prompted this study, Reto Zach and Jim Betteridge for other incidental observations, Shauna Hewson and Bill Watkins for helpful discussions and for sharing their findings, Randy Mooi and Janice Klapecki for information on specimens in The Manitoba Museum, and Reto Zach and a reviewer for constructive comments on draft manuscripts. Finally, I thank Sharon Taylor for encouraging me to study our little four-legged neighbours.

1. Preston WB (1982) The Amphibians and Reptiles of Manitoba. Manitoba Museum of Man and Nature, Winnipeg, MB.

2. Brodman R (2009) *Ambystoma laterale* Hallowell, 1856, blue-spotted salamander. Modified from: Lannoo M (ed) Amphibian Declines: the Conservation Status of United States Species, University of California Press, Berkeley, CA. In: Amphibiaweb: Information on amphibian biology and conservation [web application]. Available at: <http://amphibiaweb.org/>.

3. Taylor P (2006) Calling periods for frogs and toads near Pinawa, Manitoba, with an update on Mink Frog and Green Frog distribution. *Blue Jay* 64:44-55.

4. Hughes M (2009) Species diversity of dragonflies and damselflies (Odonata) at a Manitoba pond. *Blue Jay* 67:242-248.

5. Collicutt D (2009) Blue Spotted Salamander! Online essay. Available at: <http://www.naturenorth.com/spring/creature/bluespot/Fblspot.html>.

6. Hulse AC, Mccoy CJ, Censky EJ (2001) Amphibians and Reptiles of Pennsylvania and the Northeast. Cornell University Press, Ithaca, NY.

7. Lowcock LA, Griffith H, Murphy RW (1991) The *Ambystoma jeffersonianum-laterale* complex in central Ontario: ploidy structure, sex ratio, and breeding dynamics in a bisexual-unisexual community. *Copeia* 1991:87-105.

8. Lowcock LA, Griffith H, Murphy RW (1992) Size in relation to sex, hybridity, and breeding dynamics in central Ontario populations of the *Ambystoma jeffersonianum-laterale* complex. *Journal of Herpetology* 26:46-53.

9. Regosin JV, Windmiller BS, Homan RN, Reed JM (2005) Variation in terrestrial habitat use by four pool-breeding amphibian species. *Journal of Wildlife Management* 69:1481-1493.

10. Storey KB, Storey JM (1986) Freeze tolerance and intolerance strategies of winter survival in terrestrially-hibernating amphibians. *Comparative Biochemistry and Physiology* 83A:613-617.

11. Harding JH (1997) Amphibians and Reptiles of the Great Lakes Region. University of Michigan Press, Ann Arbor, MI.

12. Marshall WS, (2009) Terrestrial locomotion. Online essay. Available at: <http://people.stfx.ca/bmarshal/201/terrestrialloco.html>.

13. O'Reilly JC, Summers AP, Ritter DA (2000) The evolution of the functional role of trunk muscles during locomotion in adult amphibians. *American Zoologist* 40:123-135.

14. Brodie ED Jr (1977) Salamander antipredator postures. *Copeia* 1977:523-535.

PLANTS

THE BUGSEEDS *(CORISPERMUM)* OF THE PRAIRIE PROVINCES

Diana Bizecki Robson

The Manitoba Museum, 190 Rupert Avenue, Winnipeg, Manitoba R3B 0N2; E-mail: <drobson@manitobamuseum.ca>

Introduction

The bugseeds (*Corispermum* spp.) are a genus of annual plants that are relatively uncommon and favour sandy habitats, such as sand dunes and disturbed sandy soils. The common name is a direct translation of the Greek name (*coris* = bug, *spermum* = seed).[1] Older floras considered several of the bugseed species in North America to be introduced from Europe, namely *C. hyssopifolium* L., *C. nitidum* Kit., and *C. orientale* Lam.[2–5] However, recent research on the genus, including palaeobotanical evidence, suggests that the species found in North America are native and unrelated to European flora, sharing a closer affinity with eastern Asian species.[6–8] Thus the scientific names that our *Corispermum* taxa were given previously are now considered invalid; new names that more accurately reflect the uniqueness and American origin are now being used.[1] In this paper, I will: (1) discuss the taxonomy, habitat, distribution, and ecology of the bugseed genus *Corispermum*, (2) describe the characteristics of *Corispermum* species, and (3) present a taxonomic treatment of the genus consisting of a dichotomous key and descriptions of the five species found in Canada. All species but one, namely Hooker's bugseed (*C. hookeri*), have been found in the United States as well.

In North America, the bugseed genus consists of 11 species, but in the prairie provinces, there are only four: American bugseed (*C. americanum* (Nutt.) Nutt. var. *americanum*), Hooker's bugseed (*C. hookeri* Mosyakin var. *hookeri*), Pallas bugseed (*C. pallasii* Steven), and hairy bugseed (*C. villosum* Rydb.).[1] Older Canadian floras, such as Budd's Flora[2] and Flora of Alberta[3], typically recognize two to four taxa (Table 1). However, the keys in these older floras are not particularly useful for identifying the new species. For example, what was called bugseed (*C. hyssopifolium* L.) in Budd's Flora could actually be American, Hooker's, or Pallas bugseed. Some of the bugseed plants growing in the Athabasca Sand Dunes in northern Saskatchewan appear to represent a fifth species for the prairies: Alaskan bugseed (*C. ochotense* Ignatov).[8] Herbarium specimens of bugseed from that area observed by Dr. Sergei Mosyakin were annotated to Alaskan bugseed from bugseed (*C. hyssopifolium*) but were noted as being "transitional" to hairy bugseed. Thus it is possible that there are unusual hybrids between Alaskan and hairy bugseed plants in that area. Given that there are several endemic plant species in the Athabasca Sand Dunes, this is certainly a possibility.

Since there have been many changes to bugseed nomenclature, it will be less confusing to simply use the new keys in this article rather than alter the old ones. Contrary to previous keys, the hairiness of the plants is not a reliable character

Table 1. Summary of bugseed *(Corispermum)* synonomy in four major Canadian floras. Superscripts refer to references.

Common name	Scientific name(s)				
	Flora of North America[1]	Budd's Flora[2]	Flora of Alberta[3]	Flora of Canada[5]	Flora of Manitoba[4]
American bugseed	*C. americanum var. americanum*	*C. hyssopifolium*	*C. nitidum*	*C. nitidum*	*C. nitidum*
Hooker's bugseed	*C. hookeri var. hookeri*	*C. hyssopifolium*	*C. hyssopifolium*	*C. hyssopifolium var. hyssopifolium*	*C. hyssopifolium* *C. simplicissimum*
Pallas bugseed	*C. pallasii*	*C. hyssopifolium*	*C. hyssopifolium*	*C. hyssopifolium var. hyssopifolium*	*C. hyssopifolium* *C. simplicissimum*
Hairy bugseed	*C. villosum*	*C. orientale var. emarginatum*	*C. hyssopifolium* *C. nitidum*	*C. hyssopifolium var. emarginatum*	*C. orientale var. emarginatum*

Table 2. Current national and subnational status ranks for bugseed *(Corispermum)* taxa in Canada and the prairie provinces (Alberta, Saskatchewan, Manitoba). Status ranks are based on NatureServe (NS) and the Canadian Endangered Species Conservation Council (CESCC).[27,28] NS status ranks are as follows: 1 = Critically Imperilled; 2 = Imperilled; 3 = Vulnerable; U = Uncertain; NR = Not ranked. CESCC status ranks are: 2 = May Be At Risk; 3 = Sensitive; 5 = Undetermined.

Species	Status ranks							
	Canada		AB		SK		MB	
	NS	CESCC	NS	CESCC	NS	CESCC	NS	CESCC
C. americanum var. *americanum*	NR	2	NR	5	2	2	2-3	2
C. hookeri var. *hookeri*	4-5	3	NR	5	NR	2	1-2	2
C. ochotense var. *ochotense*	2-3	2	-	-	U	-	-	-
C. pallasii	NR	3	-	-	-	3	U	5
C. villosum	3-4	3	-	-	-	3	2	2

Figure 1. Habitat of hairy bugseed on dunes in Grand Beach Provincial Park, Manitoba. Diana Bizecki Robson.

for distinguishing the new species; rather, the most important characters are the size of the fruits, the presence or absence of a wing, and the density of the inflorescences.[8,9] For this reason, identification of bugseed species can be difficult when the plant is very young, as mature fruits are generally needed for positive identification.

Habitat and Distribution

Bugseed plants are typically found on soils high in sand and gravel such as sand dunes (Fig. 1), sandy plains, sandy and gravelly shores of rivers and streams, and sandy waste places.[10] Several specimens have been found in sandy cultivated fields and along road grades.[10] Bugseeds are among the few species that are capable of growing on active sand dune complexes. Due to the stabilization of many active sand dune complexes in western Canada, particularly in Manitoba, habitat for these species may be declining.[11] However, the current dune stabilization trend may reverse itself if climate change results in severe and prolonged droughts on the prairies.[12]

Bugseed species are most commonly found in the Prairie ecozone and less commonly in the Boreal Plain ecozone.[13] The farthest northern bugseed records in the prairies are from the Athabasca Sand Dunes of Saskatchewan. However, most bugseed plants in Saskatchewan are found in the south, along the sandy banks of the Frenchman, Qu'Appelle, and North and South Saskatchewan Rivers, and in the dunes of the Dundurn, Elbow, Great, Pelican Lake, and Seward Sand Hills. In Alberta, bugseeds have been found along the sandy banks of the Athabasca, Elbow, and Red Deer Rivers, and in the dunes of the Battle River, Beaver Hill, Buffalo Park, Fish Lake, Edson, and Middle Sand Hills. Manitoba plants have been found in the dunes of the Routledge and Brandon Sand Hills, the gravel pits around Birds Hill Provincial Park, and along the sandy shores of Lakes Manitoba and Winnipeg. As the bugseeds lack colourful, attractive flowers and look similar to the several weedy species, it is quite possible that the plants are much more widespread, but under-collected by amateur and professional botanists alike.

Biology

All bugseeds are annual, bisexual plants that are wind pollinated.[8] In Canada, plants begin growing in July, producing ripe seed in late August to early October. The seeds of bugseed may be retained on the parent plant over the winter, which may then be buried by shifting sand.[14] Seeds that do fall are blown by the wind and accumulate unevenly in small depressions where they are subsequently buried.[15] Bugseeds form an effective seed bank in the soil due to their innate dormancy, seed longevity, large quantity of seeds produced, and ability to resist decay and dessication.[15,16] The ability of bugseeds to grow in low-nutrient soils is likely due in part to the relatively large seeds (1.3 to 2.8 mg), which provide germinating plants with adequate resources for their initial growth.[16,17] Seeds buried at greater depths tend to have longer hypocotyls.[16] Bugseeds have low mortality regardless of burial depth, and the seeds are quite long lived, likely more than 20 years.[15] Once buried seeds are exposed due to dune erosion, the seeds become active and will germinate quickly, as long as adequate moisture is available.[15] Two to 4 weeks of cold-moist pretreatment were found to be effective in accelerating germination.[14] Plant size tends to be higher in spots where buried organic matter occurs.[14] Fluctuations in the population sizes of annual psammophilic (sand-loving) plants are likely related to inter-annual variation in rainfall.[18,19] Factors that negatively affect plant size and seed production in bugseeds include the degree of stabilization of the sand and the level of herbivory. Both plant size and reproductive allocation is lower in highly mobile habitats, and when herbivory is high.[20,21]

Economic Impact

Bugseeds are in the goosefoot family, which contains both economically valuable edible species, like spinach (*Spinacia oleracea* L.), quinoa (*Chenopodium quinoa* Willd.), and beet and Swiss chard (*Beta vulgaris* L.), as well as noxious weeds, such as Russian pigweed (*Axyris amaranthoides* L.), summer cypress (*Kochia scoparia* (L.) Schrad.), and Russian thistle (*Salsola tragus* L.).[22] Some species are considered to be both; for example, lamb's-quarters (*Chenopodium album* L.), considered a troublesome weed in croplands, is also a nutritious potherb.[22] In China, one species of bugseed (*C. declinatum* Stephan ex. Iljin) is used to flavour gin.[23] There is also evidence that the Hopi Indians of Arizona consumed bugseed seeds, as charred remains were found in ancient hearths along with maize (*Zea mays* L.) and other wild seeds.[24] The potential of bugseeds to become crop plants has not been explored. Despite the annual habit and tolerance of mild disturbance that bugseeds possess, they have not become troublesome weeds in croplands, possibly because they are susceptible to damping-off fungi when grown in finer soils high in organic matter;[14] this tendency may limit the agricultural potential of wild bugseeds in all but sandy soils.

In northern China where desertification is severe, bugseeds are noted to play an important role in stabilizing degraded sandy lands.[21,25] This is because bugseeds form an effective seed bank in the soil due to their innate dormancy, seed longevity, large quantity of seeds produced, and ability to resist decay and desiccation.[16,23] North American bugseeds could potentially be used for ecological reclamation of reactivated dunes and/or sandy areas disturbed during sand and gravel mining, road construction, or oil and gas exploration.[26] Unfortunately, seeds of this species are not typically available from seed suppliers.

Status of the Bugseeds

The current status ranks of bugseeds

according to NatureServe[27] and the Canadian Endangered Species Conservation Council[28] are noted in Table 2. However, these ranks are somewhat inaccurate because new information on the distribution and abundance of bugseed species in Canada based on a recent review of herbarium specimens has not been incorporated yet.[10]

The rarity of some bugseed species and drastic changes in the taxonomy makes collection and identification of plants in this genus challenging. They are typically overlooked and seldom collected or photographed due to their lack of large, colourful flowers. Additional research on the current distribution and abundance of bugseed plants is needed to more accurately rank the bugseed species in the prairies. Any specimens observed are worth collecting and donating to herbaria to better determine the distribution and frequency of these species. Mature specimens with well-developed fruits are the easiest to identify; immature specimens may be unidentifiable even by an expert. In general, the best time to collect bugseed specimens is from August to October.

Description of Corispermum[1,8,9]

This genus contains annual herbs, most of which possess branched, almost star-like hairs. The stems are erect or ascending, branched, and unarmed. The leaves are alternate and sessile on the stem, linear to linear-lanceolate in shape, with entire margins, a truncate base, and an acute apex. The inflorescences consist of terminal spikes with ovate, lanceolate, or linear leafy bracts. The flowers are solitary in the axils of the bracts and imperfect, with one scale-like sepal. The flower consists of one to three, rarely five, stamens and a superior ovary with two stigmas and styles. The styles persist to form a distinct "beak" at the apex of the fruit. The fruits are lens-shaped, ovate, obovate, elliptic, or orbiculate in shape, usually broadest beyond the middle, somewhat convex on one side and concave on the other, and often possessing a wing around the margin that connects to the beak (Fig. 2). The apices of the fruits are acute, glabrous and shiny or maculate and verrucose. The pericarp adheres strongly to the seed, but in *C. pallasii* they may flake off, forming small whitish bladders. To differentiate bugseeds from Russian thistle, the leaf tips must be examined closely: Russian thistle has a spine on the very tip of the leaf, whereas bugseeds merely have an acute tip. Another similar plant, summer cypress, has three to five sepals and wingless egg-shaped seeds. To aid in identification, a key to the taxa as well as photographs of Agriculture & Agri-Food Canada Vascular Plant Herbarium (DAO) specimens are provided. Note that this key can be used to identify any bugseed taxa found in all of Canada, not just the prairies.

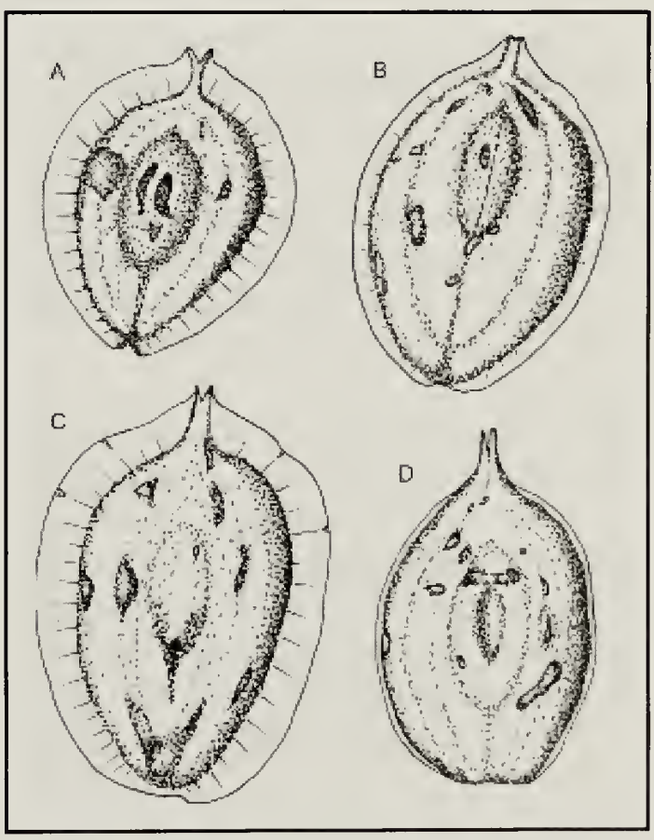


Figure 2. Illustrations of American bugseed (A), Hooker's bugseed (B), Pallas bugseed (C) and hairy bugseed (D) seeds. Drawn to scale. Line drawings by Diana Bizecki Robson

Identification Key to the Corispermum Taxa of the Prairies[1,8,9]

1a. Fruits 1.8–3.2 mm long, wingless, or with a barely visible narrow wing less than 0.1 mm wide; beak protruding well past the edge of the wing ..... *C. villosum*

1b. Fruits 2.3–5.0 mm, wings 0.1–0.5 mm wide, if almost wingless, then fruits 3.5–5.2 mm wide; beak barely protruding past the edge of the wing 2

2a. Plants 5–15(–20) cm; fruits reddish brown or olive green tinged with red, typically developed in axils of middle and lower leaves; arctic or subarctic ..... *C. ochotense*

2b. Plants 5–60 cm; fruits yellowish, brown, or olive, developed only in axils of inflorescence bracts; temperate regions 3

3a. Inflorescences at maturity narrowly linear or linear, lax, usually interrupted from base to apex; leaf blades narrowly linear ..... *C. americanum*

3b. Inflorescences at maturity linear-clavate to ovate, rather dense or at least condensed towards apex; leaf blades narrowly lanceolate, linear-lanceolate, or linear 4

4a. Fruits wingless or wings 0.1–0.2 mm wide; fruit body usually strongly convex abaxially, plane to strongly concave adaxially ..... *C. hookeri*

4b. Fruits with wings 0.2–0.5 mm wide, slightly convex abaxially, plane to slightly concave adaxially ..... *C. pallasii*

Descriptions of Bugseed Species[1,8,9]

The plants are arranged alphabetically by their scientific names. After each name is a list of the synonyms (i.e. former names) for that species. The flowering period is noted in the descriptions, but it can vary considerably depending on the geographic location and weather conditions.

1. Corispermum americanum (Nutt.) Nutt. var. americanum – American bugseed

[*C. hyssopifolium* L. var. *americanum* Nutt., *C. h.* L. var. *rubricaule* Hook., *C. imbricatum* A. Nels., *C. nitidum* auct. non Kit. ex Schultes, *C. marginale* Rydb., *C. orientale* auct. p.p. non Lam., *C. simplicissimum* Lun.]

An herbaceous annual branched from or beyond the base, 10–35(–50) cm tall. Stems sparsely covered with forking or star-like hairs, often becoming glabrous with age. Leaf blades linear or narrowly linear, plane or folded, 1.3–3.5(–4) cm long and 0.1–0.3 cm wide. Inflorescences usually lax and interrupted, rarely condensed distally, linear, narrowly linear, or occasionally narrowly club-shaped. Bracts ovate-lanceolate, lanceolate, linear-lanceolate, or occasionally proximal ones almost linear, much longer than distal, 0.5–2(–3.5) cm long and (0.2–)0.3–0.7 cm wide. Fruits yellowish brown, greenish brown, light brown or brown, often with reddish brown spots and whitish warts, slightly convex on one side and plane or slightly concave on the other, obovate or obovate-elliptic, shiny or dull, (2.3–)2.5–3.5 mm long and 2–3.5 mm wide; wing translucent, thin, 0.2–0.3 mm wide, margins entire or rarely irregularly toothed, apex broadly triangular, less commonly truncate or rounded. July–September. Native and uncommon in sand dunes, hills and plains, and sandy disturbed areas in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Quebec (Fig. 3, see inside front cover, top).

2. Corispermum hookeri Mosyakin – Hooker's bugseed

[*C. hyssopifolium* auct. p.p. non L., *C. orientale* Lam. var. *emarginatum* auct. p.p.

non (Rydb.) Macbr.]

An herbaceous annual plant often branched from the base, 10–40(–60) cm tall. Stems sparsely covered with forking and almost star-like hairs. Leaf blade narrowly lanceolate or linear lanceolate, plane, 2–5 cm long and (0.1–)0.2–0.5(–0.6) cm wide. Inflorescences usually dense, ovoid, ovate-cylindric, club-shaped, rarely interrupted near base in outline. Bracts ovate or ovate-lanceolate, strongly overlapping, 0.5–1.5(–2) cm long and 0.3–1 cm wide. Fruits usually deep olive green, brown, or rarely almost black, usually without spots or warts, strongly convex on one side and prominently concave to almost plane on the other, oblong-obovate to obovate, (3.2–)3.5–4.5(–5) mm long and 2.2–3.3(–3.5) mm wide; wing, if present semi translucent to 0.2 mm wide, margins entire, apex rounded, or indistinctly triangular. July–September. Native and uncommon in sand dunes, hills, and plains, less common in sandy disturbed areas in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and the Northwest Territories (Fig. 4, see inside front cover, top). There are two varieties in Canada, but *C. h.* var. *pseudodeclinatum* has so far only been found in southern British Columbia. The following key can be used to differentiate the two varieties:

1a. Inflorescences dense throughout, rarely interrupted; fruits oblong-ovate to obovate..... ..... *C. h.* var. *hookeri*

1b. Inflorescences dense only at apex, interrupted; fruits elongate to oblong-obovate, two times as long as broad .... *C. h.* var. *pseudodeclinatum*

3. Corispermum ochotense Ignatov – Alaskan bugseed

An herbaceous annual usually branched from the base or nearly so, 5–15(–20) cm tall. Stems sparsely covered with forking or star-like hairs, becoming glabrous with age. Leaf blades linear-oblanceolate, or linear, plane, 1–3.5 cm long and 0.1–0.3 cm wide abruptly contracted into a mucronulate apex. Inflorescences compact and dense, short-clavate, almost ovoid, or linear and with leaf-like bracts. Bracts ovate-lanceolate, lanceolate, or linear-lanceolate (0.5–)1–1.5(–3) cm long and (0.1–)0.2–0.5 cm wide. Fruits beet red, reddish brown, dark brown, or deep olive green and typically tinged with red, usually without dark spots or whitish warts, strongly convex abaxially, plane or slightly convex adaxially, obovate-elliptic or almost obovate, broadest near the middle dull, (2.5–)2.8–4 mm long and 1.8–2.7 mm wide; wing (0.1–)0.2–0.3 mm wide, margins entire, apex broadly triangular or almost rounded, thick and translucent only at margins. July–September. Native and uncommon in sand dunes, sandy and gravely shores, and disturbed sandy soils in the arctic and subarctic of the Northwest Territories and the Yukon, and possibly northern Saskatchewan, although no definitive specimens have been collected yet. There are two varieties of this species in Canada, but the specimens found in Saskatchewan appeared to be variety *ochotense*. The two varieties can be distinguished using the following key:[8]

3a. Fruits (2.5)2.8–3.2 mm long × 1.8–2.2 mm wide..... ..... *C.o.* var. *ochotense*

3b. Fruits 3.2–4 mm long × 2.2–2.7 mm wide..... *C.o.* var. *alaskanum*

4. Corispermum pallasii Steven – Pallas bugseed

[*C. hyssopifolium* L. var. *leptopterum* Asch., *C. leptopterum* (Asch.) Iljin, *C. sibiricum* Iljin ssp. *baicalense* Iljin]

An herbaceous annual branched from near the base, 10–45(–60) cm tall. Stems sparsely covered with forking or almost star-like hairs, becoming glabrous with age. Leaf blades linear-lanceolate, linear or occasionally narrowly linear, plane,

1.5–4 cm long and (0.1–)0.2–0.4(–0.5) cm wide. Inflorescences compact and dense, rarely lax and interrupted, club-shaped or almost ovate in outline. Bracts ovate or ovate lanceolate, (0.5–)1–3 cm long and 0.4–0.8 cm wide. Fruits light to dark brown or deep olive green, often with reddish brown spots and whitish warts, convex on one side and plane or slightly concave on the other, obovate or obovate-elliptic, (3.2–)3.5–4.5(–4.7) mm long and (2–)2.4–5 mm wide; wing translucent only at the margin, thick, 0.2–0.4(–0.5) mm wide, margins entire or irregularly toothed, apex broadly triangular, rarely rounded or indistinctly emarginated. July–September. Native and uncommon in sand hills and plains, and disturbed sandy/gravelly soils in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Quebec.

5. Corispermum villosum Rydb. – Hairy bugseed

[*C. emarginatum* Rydb., *C. hyssopifolium* L. var. *emarginatum* (Rydb.) Boiv., *C. orientale* Lam. var. *emarginatum* (Rydb.) Macbr.]

An herbaceous annual usually branched from the base or nearly so, (5–)10–30(–35) cm tall. Stems densely or sparsely covered with forking or star-like hairs, occasionally becoming glabrous with age. Leaf blade linear-oblanceolate, linear or rarely narrowly linear, plane, (1–)1.5–3.5 cm long and (0.1–)0.2–0.3 cm wide. Inflorescences compact and dense, condensed in distal half, usually club-shaped to somewhat linear in outline. Bracts ovate, ovate lanceolate, or narrowly ovate-lanceolate 0.5–1.5 (–2.5) cm long and (0.3–)0.5–1 cm wide. Fruits yellowish brown, or light to dark brown, usually with reddish brown spots and occasionally whitish warts, strongly convex on one side, plane or slightly convex on the other, elliptic or obovate-elliptic, dull, beak protruding above the seed, 1.8–3(–3.2) mm long and 1.5–2 mm wide; wing absent or to 0.1 mm wide, margins entire, apex triangular. July–September. Native and uncommon in sand dunes, hills and plains, and disturbed sandy soils in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Northwest Territories (Fig. 5, see inside front cover, top).

Acknowledgements

Financial support for this research was received from The Manitoba Museum Foundation Inc. Dr. Vernon Harms graciously reviewed an earlier version of this manuscript. Collections at the following herbaria were examined: University of British Columbia (UBC), Royal British Columbia Museum (V), University of Alberta (ALTA), University of Calgary (UAC), Royal Alberta Museum (RAB), University of Regina (USAS), University of Saskatchewan (SASK), University of Manitoba (WIN), The Manitoba Museum (MMMN), Royal Ontario Museum (ROM), University of Guelph (OAC), University of Western Ontario (UWO), University of Waterloo (WAT), University of Toronto (TRTE), Agriculture & Agri-Food Canada Vascular Plant Herbarium (DAO), Canadian Museum of Nature (CAN), University of Montreal (MT), McGill University (MTMG), University of Laval (QFA), and the Government of Quebec (QUE).

1. Welsh SL, Crompton CW, Clemants SE (2003) Chenopodiaceae. In: Flora of North America Editorial Committee (eds) Flora of North America, Vol 4. Oxford University Press, New York, NY, p 258-404.

2. Looman J, Best KF (1979) Budd's Flora of the Canadian Prairie Provinces. Canadian Government Publishing Centre, Supply and Services Canada, Hull, QC.

3. Moss EH (1983) Flora of Alberta (2nd edn by J.G. Packer). University of Toronto Press, Toronto, ON.

4. Scoggan HJ (1956) Flora of Manitoba. National Museum of Canada, Ottawa, ON.

5. Scoggan HJ (1978) The Flora of Canada. National Museum of Canada, Ottawa, ON.

6. Betancourt JL, Long A, Donahue DJ, Jull AJ, Zabel TH (1984) Pre-Columbian age for North American *Corispermum* L (Chenopodiaceae) confirmed by accelerator radiocarbon dating. *Nature* 311:653-655.

7. Matthews JV, Schweger CE, Hughes OL (1990) Plant and insect fossils from the May Indian village section (central Yukon): new data on middle Wisconsinan environments and glaciation. *Geographie Physique et Quaternaire* 44:15-26.

8. Mosyakin SL (1995) New taxa of *Corispermum* L. (Chenopodiaceae), with preliminary comments on the taxonomy of the genus in North America. *Novon* 5:340-353.

9. Sukhorukov AP (2007) Fruit anatomy and its taxonomic significance in *Corispermum* (Corispermoideae, Chenopodiaceae). *Willdenowia* 37:63-87.

10. Robson DB (In press) An analysis of the distribution, ecology and status of bugseeds (*Corispermum*) in Canada. *Canadian Field Naturalist*.

11. Hugenholtz CH, Wolfe SA (2005) Recent stabilization of active sand dunes on the Canadian prairie and relation to recent climate variations. *Geomorphology* 68:131-147.

12. Wolfe S, Thorpe J (2005) Shifting sands: climate change impacts on sand hills in the Canadian prairie and implications for land use management. *Prairie Forum* 30:123-142.

13. Marshall IB, Schut PH (1999) A national ecological framework for Canada. Ecosystems Science Directorate, Environment Canada and Research Branch, Agriculture and Agri-food Canada, Ottawa, ON.

14. Van Asdall W, Olmstead CE (1963) *Corispermum hyssopifolium* on the Lake Michigan dunes - its community and physiological ecology. *Botanical Gazette* 124:155-172.

15. Zhang J, Maun MA (1994) Potential for seed bank formation in seven Great Lakes sand dune species. *American Journal of Botany* 81:387-394.

16. Maun MA, Lapierre J (1986) Effects of burial by sand on seed germination and seedling emergence of four dune species. *American Journal of Botany* 73:450-455.

17. Stevens OA (1932) The number and weight of seeds produced by weeds. *American Journal of Botany* 19:784-794.

18. Li FR, Zhao LY, Zhao XY, Zhang TH, Li G (2005) The relative importance of pre- and post-germination determinants for recruitment of an annual plant community on moving sandy land. *Annals of Botany* 96:1215-1223.

19. Robson DB (2006) A conservation evaluation of smooth goosefoot, *Chenopodium subglabrum* (Chenopodiaceae), in Canada. *Canadian Field Naturalist* 120:335-341.

20. Gedge KE, Maun MA (1992) Effects of simulated herbivory on growth and reproduction of two beach annuals *Cakile edentula* and *Corispermum hyssopifolium*. *Canadian Journal of Botany* 70:2467-2475.

21. He YH, Zhao HA, Liu XP, Zhao XY, Zhang TH, Drake S (2009) Reproductive allocation of *Corispermum elongatum* in two typical sandy habitats. *Pakistan Journal of Botany* 41:1685-1694.

22. Robson DB (2008) The prairie goosefoots. *Blue Jay* 66(2):82-95.

23. Zhu G, Mosyakin SL, Clemants SE (2003) Chenopodiaceae. In: Wu Z, Raven PH (eds) Flora of China, Vol 5. Science Press, Beijing & Missouri Botanical Garden Press, St. Louis, MO, p 351-414.

24. Adams C (2004) Homol'ovi IV: The First Village. Arizona State Museum Occasional Electronic Papers No. 1, Arizona State Museum, University of Arizona, Tuscon, AZ.

25. Liu M, Jiang G, Yu S, Li Y, Li G (2009) The role of soil seed banks in natural restoration of the degraded Hunshandak Sandlands, Northern China. *Restoration Ecology* 17:127-136.

26. Kelso T, Bower N, Halteman P, Tenney K, Weaver S (2007) Dune communities of SE Colorado: patterns of rarity, disjunction and succession. In: Barlow-Irick P, Anderson J, McDonald C (eds) Southwestern Rare and Endangered Plants: Proceedings of the 4th conference. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO, p 39-48.

27. NatureServe (2010) NatureServe Explorer: an online encyclopedia of life [web application]. Version 6.0. NatureServe, Arlington, VA. Available at <http://www.natureserve.org/explorer>.

28. Canadian Endangered Species Conservation Council (CESCC) (2006) Wild Species 2005: the general status of species in Canada. Available at: <http://www.wildspecies.ca/wildspecies2005/GS2005_site_e.pdf.

HUMAN DIMENSIONS

ENHANCING CONSERVATION BENEFITS FROM WILDLIFE FESTIVALS AND ECOTOURISM ACTIVITIES

Glen T. Hvenegaard[1], Nhial Tiitmamer Kur

Department of Science, University of Alberta, Augustana Campus, 4901-46 Avenue, Camrose, AB T4V 2R3

[1]E-mail: <glen.hvenegaard@ualberta.ca>

Abstract

Wildlife festivals, i.e., short-term celebrations of local natural wildlife features, are growing in number across North America. To be considered ecotourism activities, wildlife festivals should focus on natural areas, deliver environmental education, and promote sustainability. The goal of this article is to identify the potential conservation impacts of wildlife festivals and promote ways to improve the conservation benefits. The potential conservation benefits are not well documented and include political incentives to protect habitat, revenues for management, local economic incentives to conserve habitat, alternatives to wildlife-unfriendly land uses, and environmental education that generates conservation action. Recommendations to enhance these conservation impacts include: documenting and publicizing local economic impacts, using financial mechanisms for local sustainability projects, using local services and sponsors, addressing relevant legislation and policies and interests, using effective interpretation, involving and empowering the local community, and developing a comprehensive environmental ethic of

Figure 1. Wildlife festivals can demonstrate techniques for wildlife conservation. Here local purple martin experts, Dan Olofson and Bob Buskas, discuss nest box issues at the Camrose Purple Martin Festival in Alberta. *Glen Hvenegaard*

operation. We conclude with an overview of wildlife festivals in the prairie provinces of Canada.

Introduction

Wildlife festivals typically involve host communities that facilitate short-term celebrations of local natural wildlife features. The names of wildlife festivals vary greatly (e.g., festival, fest, celebration, jamboree, chase), and can focus on individual species (e.g., purple martins, Fig. 1), groups of species (e.g., dragonflies, shorebirds, waterfowl), or birds or wildlife in general. The focus of most festivals is on birds (specific or general) or wildlife in general. Common festival activities include presentations, guided walks, birding competitions, wildlife carving competitions, children's crafts, and trade shows.[1]

The number of festivals in North America has grown from 10 in 1992 to over 240 in 2002.[2-5] Wildlife festivals are less common in other regions of the world. In 2010, Canada hosted 90 wildlife festivals, of which 22 were in the prairie provinces (14 in Alberta, 8 in Saskatchewan, and 3 in Manitoba).[6] Festivals are typically offered in rural areas near habitats that support the target wildlife species, particularly in protected areas.[7] Wildlife festivals are open to the public, typically last only 1 to 4 days, and involve many volunteers from community groups, conservation organizations, and tourism agencies.[8] Attendance can range from a few dozen to several thousand. Attendees are relatively educated, affluent, and older than the general population.[9] Local economic impacts can be significant, especially if the festival attractions and length encourage participants to stay overnight, resulting in higher expenditures for food and accommodation.[9]

Festivals can help enhance a community's image, generate local economic impacts, provide recreational opportunities, and develop a local sense of community. However, any wildlife festival should also help protect the natural environment, particularly the local wildlife species and habitats that are being celebrated by the festival.[10-13]

A focus on this last goal would be more in line with the objectives for ecotourism in general.[14,15] The core criteria of ecotourism focus on nature-based activities, environmental education, and sustainability.[14,16-18] Thus, true ecotourism activities are characterized by nature appreciation and learning in natural settings, with management following sustainability practices for economic and socio-cultural systems.[19,20] Many wildlife festivals promote the general principles of ecotourism, but often do so in a diffuse and superficial manner.[4,11,21] The purpose of this paper is to highlight the recent surge in wildlife festivals, identify potential conservation impacts, and promote ways to improve the environmental benefits. We conclude with an overview of wildlife festivals in the prairie provinces of Canada.

Identifying the Potential Conservation Impacts

Ecotourism activities, such as wildlife festivals, have the potential to both harm and help the target species and their habitats.[22] On the negative side, research has demonstrated many ways that recreational activities (such as those promoted by wildlife festivals) can harm wildlife. Knight and Cole (1991) provided a useful overview of the mechanisms involved.[23] First, festival activities can modify habitats that are critical for key stages in a species' life cycle (e.g., through development and trampling). Second, activities can also contribute to environmental pollution, through emissions to the air, water, and soil. Last, activities can disturb individuals and

populations, both over the short and long term.

Negative short-term impacts on individual animals can include changes to behaviours (e.g., birds are flushed by bird watchers coming too close) or death (e.g., birds colliding with a vehicle traveling to a festival location). Long-term impacts on individuals include altered behaviour (e.g., animals avoiding areas visited by wildlife viewers), altered vigour (e.g., poor nutrition among subadults who cannot access the best feeding sites), altered productivity (e.g., smaller clutch size of nesting species), or delayed death (e.g., insufficient food due to lack of access to resources). Long-term impacts on populations are reflected in changes to abundance (e.g., declining populations of targeted species), distribution (e.g., species changing common feeding areas), or demographics (e.g., skewed gender or age ratios). Long-term impacts on communities include changes to species composition (e.g., local extirpations, increase in non-native species) and subsequent interactions (e.g., competition, predation).

The positive conservation impacts of wildlife festivals are not well documented and have fairly weak causal links.[24] Moreover, it is difficult to measure the influence of festival factors on wildlife conservation because the causes and effects are embedded in larger scales over space and time. Nevertheless, there are at least five ways in which wildlife species and their habitats can benefit from wildlife festivals in particular and ecotourism in general:[9] (1) The economic activity and public profile generated by wildlife festivals can provide incentives to establish protected areas around critical wildlife habitat.[25] (2) Revenues from festivals can be used for enhanced management of wildlife and habitat.[26] (3) The economic impacts of festivals in nearby communities can encourage residents to conserve wildlife.[27,28] (4) The use of wildlife in related festivals can provide alternatives to other uses that cause more environmental damage.[29,30] (5) festivals can generate support for conservation by educating local and non-local participants.[13]

Enhancing Positive Conservation Impacts

Considerable research is available on the negative conservation impacts of wildlife-viewing activities.[23] Thus, wildlife festival organizers can address the impacts of these activities in many ways. Potential strategies include selecting appropriate activities, adhering to sound wildlife-watching guidelines, limiting group size, and avoiding sensitive habitats and species.

Limited research has been done on the positive conservation impacts of wildlife festivals and the key influencing factors.[9] Nevertheless, the ecotourism and conservation literature provides valuable and concrete recommendations that can enhance these potential conservation benefits. These suggestions revolve around economic incentives, legislation and policy, education, community support, and ethics of use.

First, to identify and promote incentives, organizers should document the local economic, social, and environmental impacts of a wildlife festival.[31] In particular, the economic information can convince decision makers and local residents that financial efforts to protect wildlife and habitat have economic benefits.[13,15,25] Many mechanisms can be used to generate and increase local economic impacts (e.g., fees, donations, local spending, and longer events).[28] Moreover, it is imperative to use revenues generated from wildlife festivals to fund local conservation and community

development projects that can stimulate sustainable economic activity in these largely rural areas.

Festival organizers and participants should tell tourism service providers (e.g., owners of restaurants and hotels) that money is being spent in local businesses because of local support of, or interest in, the local wildlife and wildlife festival. For example, the Great Florida Birding Trail provides calling cards for birders to give to gas stations, hotels, and restaurants that read: "I'm spending money in your community because I'm here to see your wonderful birds. Keep up the good work conserving your wildlife and wildlands, and I'll keep coming back."[32] This will encourage people to make a strong connection between the festival and economic benefits.

This logical connection is needed for both public (e.g., provincial or national park) and private (e.g., local landowners) interests so that there are market incentives to conserve wildlife.[33] Festival organizers might also seek out sponsors and partners to contribute financially, raise interest in the festival, and increase the profile of the target species and habitats. Economic incentives can also be used to maintain and increase use by visitors (e.g., loyalty benefits, identification with a festival).

Second, festival organizers should pay attention to legislation and policy frameworks. Festival activities must adhere to existing political and legal frameworks for wildlife protection in Canada.[34] This can help decrease resistance and increase support from relevant wildlife protection agencies and government departments. The involvement of political leaders is also critical: involve them in decisions, provide them with economic impact data, and invite them to present at the festival. The leaders might use the opportunity to announce an environmental protection initiative. At the very least, they will see first-hand the level of public support for wildlife protection.

Furthermore, the political leaders seek to satisfy the needs of their constituents, gain public approval, and establish their legacies.[35] Wildlife festivals can provide a venue to accomplish these goals. Birders have gone so far as to advocate for certain politicians they believe will promote the interests of birders.[36] Similarly, the Great Florida Birding Trail gives out stickers that read "Birding is big business: healthy wildlands make healthy economies" in order to promote their political cause.[32] Integrating festival activities into larger tourism initiatives (e.g., birding trails), networking (e.g., Boreal Birding Network), and conservation programs (e.g., North American Shorebird Conservation Plan) can increase political and logistical support.

Third, awareness and education can achieve long-term conservation benefits. Effective interpretation leads to wildlife protection by addressing all scales of analysis (spatial, temporal, and ecological) and by focusing on all ages and interests of visitors.[37] Organizers should move from promoting awareness and understanding to promoting concern and action, in the form of pro-environment behaviour.[37] This type of behavior requires support (e.g., information, instructions, encouragement, social networking) and rewards (e.g., recognition, personal benefits). Educational efforts should focus on environmental themes that relate to the target species of the festival, and then move on to related ecological and community concerns. It is important to encourage participants to make social, economic, scientific, or spiritual connections and action-related commitments during their visit. Since participants learn in different ways, it is

helpful to offer a variety of educational opportunities (e.g., speakers, hikes, workshops, hands-on projects, and workshops that encourage self-directed work and enable participants to apply their creativity). High-profile guest speakers can draw many people to a festival, with its attendant educational benefits. Some festival visitors can be encouraged to participate as organizers in future years or in bird censuses, which are essential for determining bird conservation priorities.

Fourth, community involvement can enhance wildlife conservation by way of long-term funding, in-kind donations, and volunteer support.[38] Diverse funding sources can trigger or leverage additional funding sources to help achieve the festival's goals. Making the connection between economic development and conservation can promote funding efforts. Ecotourism should empower and develop local communities so that wildlife festivals can justify using funds from community and economic development sources.[39] For the process to begin, the community needs to understand and see evidence of the economic benefits. However, the economic benefits should strive for balance; inequitable economic benefits (e.g., to one hotel or one protected area) can lead to conflict and declining support. Local ownership of the festivals should be encouraged for similar political and economic reasons (i.e., to enhance local benefits).

Local conservation and tourism groups can provide important volunteer support (e.g., logistics managers) and credibility (e.g., birding experts) so that the festival can engage more people. Such skills are needed for any wildlife festival, and such volunteers should be supported and recognized.[40] Local involvement to engage the cultural and natural history can enlarge the overall tourism product and appeal to festival visitors with broader interests, thus increasing local economic impacts.

Last, wildlife festival organizers should develop a project ethic to encourage efficiency and integrity. This begins with a public statement of purpose for the festival that can guide all decision making. Many festivals either do not have a statement of purpose or do not provide it to the public in their promotional information. Some purpose statements will incorporate the role of a sponsoring organization, but this must be balanced among environmental, economic, and social goals.

Festival activities should observe environmental etiquettes and minimum impact practices.[41] Monitoring efforts are needed to ensure that wildlife and their habitats are maintained or enhanced, with transparent processes and standards. This should enhance fund raising and volunteer support. Festival organizers should adopt guidelines for ecotourism practices, wildlife observation, or travel to sensitive natural and cultural areas.[5,42] These guidelines should be adapted to the local context as appropriate. Perceptive visitors, sponsors, and community members will understand and support these efforts with future visits, donations, and volunteer assistance. Overall, festival organizers should engage professional marketing expertise to successfully attract participants to the festival and to help ensure that a festival's objectives, marketing and conservation practices, and conservation outcomes are consistent.

Conclusion

Wildlife festivals are an example of an ecotourism activity with considerable potential to help conserve the wildlife species and habitats that are targeted by the festivals. Festival organizers need to be aware of festival impacts, document them, and use them for the betterment of the natural environment. This does not

require lengthy studies costing large sums of money. It simply requires a clear focus and a common-sense understanding of how local political, social, and economic systems work. Fortunately, experiences from other festival organizers can help ease the planning aspects so that festivals can achieve benefits for focal species.[40] This should be the most important goal of wildlife festivals, and of ecotourism in general.

Acknowledgements

We thank the Social Sciences and Humanities Research Council of Canada for funding support and Jody Rintoul for past research assistance.

1. Hartley D (2005) Birding festivals. *Birding* 37(1): 34-37.

2. Decray S, Green P, Payne RH (1998) The birding festival: an opportunity waiting. *Birding* (December):525-526.

3. DiGregorio L (2002) Flight path: birding festivals beckon. *Birding* 34(1):77.

4. Lawton L (2009) Birding festivals, sustainability and ecotourism: an ambiguous relationship. *Journal of Travel Research* 48:259-267.

5. National Audubon Society (1989) The National Audubon Society travel ethic for environmentally responsible travel. Available at:<http//:www.audubon.org>.

6. Hvenegaard GT, Rintoul J (2009). Explore Alberta's wildlife festivals. *Nature Alberta* 39(4): 18-20.

7. Slotkin MH (2005) Educational partnerships, sustainability, and ecotourism project development. In: Nelson G, Hronszky I (eds) Environmental Studies: Implications for Sustainability. Arisztotelész Publishing Co., Budapest, p. 81-89.

8. Lawton LJ, Weaver DB (2010) Normative and innovative sustainable resource management at birding festivals. *Tourism Management* 31:527-536.

9. Hvenegaard GT (2010) Potential conservation benefits of wildlife festivals. *Event Management* 13: S8-9.

10. Hvenegaard G, Manaloor V (2004) Current and potential expenditure patterns of birding festival participants. *Recent Advances and Research Update* 5(1):47-60.

11. Lawton L (2008) Are US-based birding festivals a form of ecotourism? Conference for Australian University Tourism and Hospitality Education. Gold Coast, Australia. Feb 11-14. Available at: <http://www.griffith.edu.au/conference/cauthe2008/working-papers/WP057.pdf>.

12. Polson J (1993) Flocking effect: Small towns learn to love birders who descend on "hot-spots". *American Birds* 47(5):1062-1070.

13. Romero A, Stangel P (1996) Festival birding: Community festivals highlight great birding, fun activities and friendly people. *Wildbird* (January): 34-39.

14. Fennell DA (2001) A content analysis of ecotourism definitions. *Current Issues in Tourism* 4(5):403-421.

15. Wunder S (2000) Ecotourism and economic incentives - an empirical approach. *Ecological Economics* 32(3):465-79.

16. Stronza A (2007) The economic promise of ecotourism for conservation. *Journal of Ecotourism* 6(3):210-230.

17. Weaver D (2001) Ecotourism. John Wiley & Sons Australia, Ltd. Milton, Australia.

18. Weaver DB (2005) Comprehensive and minimalist dimensions of ecotourism. *Annals of Tourism Research* 32(2):439-455.

19. Ross S, Wall G (1999) Ecotourism: towards congruence between theory and practice. *Tourism Management* 20(1):123-32.

20. Weaver DB, Lawton L (2007) Twenty years on: the state of contemporary ecotourism research. *Tourism Management* 28(5):1168-79.

21. Slotkin MH (2003) Ecotourism in practice: birding and wildlife festivals. In: Nelson G, Hronszky I (eds) How Science can Support Environmental Protection. Florida Tech-BME Partnership Programme Yearbook 2003. Ariszlolelesz Publishing Co., Budapest, p. 57-69.

22. Buckley R (2009) Evaluating the net effects of ecotourism on the environment: a framework, first assessment and future research. *Journal of Sustainable Tourism* 17:643-672.

23. Knight RL, Cole DN (1991) Effects of recreational activity on wildlife in wildlands. *Transactions of the North American Wildlife & Natural Resources Conference* 56:238-247.

24. Kiss A (2004) Is community-based ecotourism a good use of biodiversity conservation funds? *Trends in Ecology & Evolution* 19(5):232-237.

25. Dabrowski P (1994) Tourism for conservation, conservation for tourism. *Unasylva* 45:42-44.

26. Green P (2003) Fair for fowl: You can see it all at the British Birdwatching Fair. *Winging it* (15). Available at: <http://www.birdfair.org.uk/index.php?option=com_content&view=article&id=56&Itemid=36>.

27. Hartup BK (1994) Community conservation in Belize: demography, resource use, and attitudes of participating landowners. *Biological Conservation* 69(3):235-41.

28. Hvenegaard G, Manaloor V (2007) Snow goose festival generates economic benefits for Tofield, Alberta. *Edmonton Naturalist* 29(2):28-29.

29. Clark WR (1987) Economics and marketing of Canada's Capistrano. In: Diamond AW, Filion FL (eds) The Value of Birds. International Council for Bird Preservation, Cambridge, UK, p. 31-47.

30. Kingsmill S (1988) Swallowtown: Pembroke, Ontario, the San Juan Capistrano of the north. *Birder's World* 2(1):10-13.

31. Chambliss K, Slotkin MH, Vamosi AR (2009) The Space Coast Birding & Wildlife Festival 2009: Economic Impact Report & Demographic Profile. Brevard Nature Alliance, Brevard County, FL.

32. Great Florida Birding Trail (2010) Birding economics. Available at: <http://floridabirdingtrail.com/index.php/business/birding_economics1/>.

33. Montgomery CA, Pollack RA (1996) Economics and biodiversity: weighing the benefits and costs of conservation. *Journal of Forestry* 94(2):34-38.

34. Ceballos-Lascurain H (2001) Integrating Biodiversity into the Tourism Sector: Best Practice Guidelines. Report delivered to the United Nations Environment Programme, the United Nations Development Programme, the Global Environment Facility and the Biodiversity Planning Support Progamme. Available at: <http://www.planeta.com/ecotravel/mexico/strategy/biodiversity3.html>.

35. Rollins R, Eagles P, Dearden P (2009) Tourism, ecotourism, and protected areas. In: Dearden P, Rollins R (eds) Parks and Protected Areas in Canada: Planning and Management, 3rd edn. Oxford University Press, Don Mills, ON, p. 315-341.

36. Birders United (2010) Birders united in a new political reality. Available at: <http://www.birdersunited.com/>.

37. Ham SH (2009) From interpretation to protection: Is there a theoretical basis? *Journal of Interpretation Research* 14(2):49-57.

38. Font X, Cochrane J, Tapper R (2004) Tourism for Protected Area Financing: Understanding Tourism Revenues for Effective Management Plans. Leeds Metropolitan University, Leeds, UK.

39. Newsome D, Dowling RK, Moore S (2005) Wildlife tourism. Channel View Publications, Clevedon, UK.

40. Millar NS (2003) How to Organize a Birding or Nature Festival. American Birding Association, Colorado Springs, CO.

41. Higginbottom K (2002) Principles for Sustainable Wildlife Tourism, with Particular Reference to Dolphin-based Boat Tours in the Port Phillip Bay. Victorian Department of Natural Resources and Environment, Melbourne, Australia.

42. Wood ME (2002) Ecotourism: Principles, Practices & Policies for Sustainability. United Nations Environment Programme, Paris.

Appendix 1. Current wildlife festivals in Saskatchewan. (If you have information to update the list, please contact the authors.)

- Yellowhead Flyway Birding Trail Association Bird Symposium
  - Location: southeast Saskatchewan
  - Timing: February to April
  - Description: To promote awareness of prairie conservation issues, opportunities for habitat protection, and bird-watching potential
  - Activities: presentations, hikes, children's and youth activities
  - Phone: (306) 744-8140
  - Contact: Rob Wilson, secretary
  - E-mail: <rjwilson@sasktel.net>
- Wings over Wascana Nature Festival
  - Location: Regina, SK
  - Timing: early May
  - Description: Aimed at acquainting participants with nature and promoting fun through different wetland and wildlife activities.
  - Activities: animal presentations,

guided nature hikes, presentations, face painting, bird house building, pond dipping, and more
  - Website: <http://www.wascanamarsh.ca/wow10.htm>
  - Contact: Friends of Wascana Marsh
  - E-mail: <friendsofwascanamarsh@gmail.com>
  - Phone: (306) 585-1852
- Nature Saskatchewan Spring Meet
  - Location: variable in SK
  - Timing: early June
  - Description: Regular meeting of Nature Saskatchewan members with a goal of discovering and celebrating nature in the province.
  - Activities: field trips, bird hikes, banquet, presentations, and more
  - Website: <http://www.naturesask.ca>
  - Contact: Nature Saskatchewan
  - E-mail: <info@naturesask.ca>
  - Phone: (306) 780-9273
- Leader Birding and Tourism Festival
  - Location: Leader, SK
  - Timing: early May, alternating years (2009, 2011, ...)
  - Description: A celebration of birds offering unique opportunities for birdwatchers and nature lovers.
  - Activities: guided or self-guided tours, guest speakers, presentations, and a banquet
  - Website: <http://www.sasktourism.com/whats-happening/sasksecrets-newsletter/april-2009-home/leader-birding-festival>
  - Contact: Leader Tourism Committee
  - E-mail: <kerry.wrishko@gov.sk.ca>, <rwrishko@sasktel.net>
  - Phone: (306) 291-7781
- Bright Wings Bird Festival
  - Location: Cherry Lake
  - Timing: May
  - Description: This festival shows adults and children how they can enjoy birds and help out with nature monitoring programs and to raise money for the Last Mountain Bird Observatory.
  - Activities: Workshops, field trips, bird watching, trips by canoe and kayak
  - Website: <http://www.naturesask.ca/?s=news&p=events&id=470>
  - Contact: Trevor and Karen Herriot
  - E-mail: <kherriot@sasktel.net>
  - Phone: 306-585-1674
- Chaplin Shorebird Festival
  - Location: Chaplin, SK
  - Timing: early June
  - Description: This annual event celebrates over 30 species of shorebirds which can number in the hundreds of thousands in the area.
  - Activities: Tours
  - Website: <http://chapnc.sasktelwebhosting.com/events.htm>
  - Contact: Chaplin Tourism
  - E-mail: <chaplintourism@sasktel.net>
  - Phone: (306) 395-2223
- Native Prairie Appreciation Week
  - Location: throughout SK, with workshops in rotating locations
  - Timing: late June
  - Description: This celebration raises awareness and develops appreciation of native prairie ecosystems and their importance to Saskatchewan's provincial, environmental, and agricultural sectors.
  - Activities: workshops and field tours
  - Website: <http://www.pcap-sk.org/?s=11.native_prairie_appreciat>
  - Contact: Saskatchewan Prairie Conservation Action Plan
  - E-mail: <pcap@sasktel.net>
  - Phone: (306) 352-0472
- Nature Saskatchewan Fall Meet

- Location: variable in SK
- Timing: late September or early October
- Description: Regular meeting of Nature Saskatchewan members with a goal of discovering and celebrating nature in various parts of the province.
- Activities: field trips, bird hikes, banquet, presentations, and more
- Website: <http://www.naturesask.ca>
- Contact: Nature Saskatchewan
- E-mail: <info@naturesask.ca>
- Phone: (306) 780-9273

Appendix 2. Current wildlife festivals in Alberta. (If you have information to update the list, please contact the authors.)

- Beaverhill Lake Snow Goose Chase (Tofield)
  - Timing: late April
  - Contact: Edmonton Nature Club, <www.enc.fanweb.ca>
  - Goal: nature immersion, including birds, snakes, insects, and more
- Swan Festival (Grande Prairie)
  - Timing: late April
  - Contact: Saskatoon Island Provincial Park, <www..swanfestival.fanweb.ca>
  - Goal: Learn about trumpeter swans and conservation issues
- Red Deer River Naturalists May Species Count and Bird Festival (Red Deer)
  - Timing: late May
  - Contact: Red Deer River Naturalists, <www..rdrn.fanweb.ca/rdrn_home_page.htm>
  - Goal: May species count and exploration of local nature hotspots
- Crowsnest Wing Fest (Blairmore, Crowsnest Pass)
  - Timing: late May to early June
  - Contact: Crowsnest Conservation Society, <www.crowsnestconservation.ca >
  - Goal: Bird festival and the spring bird, mammal, and butterfly counts
- Songbird Festival (Lesser Slave Lake)
  - Timing: early June
  - Contact: Lesser Slave Lake Bird Observatory, <www.lslbo.org/songbirdfestival.asp>
  - Goal: Birding festival, bird banding, and conservation of boreal birds
- Purple Martin Festival (Camrose)
  - Timing: early June
  - Contact: Tourism Camrose, <www.tourismcamrose.com>, City of Camrose, <www..camrose.ca>
  - Goal: Birding festival with a focus on purple martins and other local wildlife
- International Migratory Bird Day Festival (Calgary)
  - Timing: early June
  - Contact: Inglewood Bird Sanctuary, <http://www.birdday.org/birdday/explorers-map>
  - Goal: Celebrate the return of migratory birds, and promote awareness of conservation issues
- Waterton Wildflower Festival (Waterton)
  - Timing: mid- to late June
  - Contact: Trail of the Great Bear, <www. watertonwildflowers.com>
  - Goal: Awareness of wildflowers and other local natural history
- Bluebird Festival (Lacombe)
  - Timing: mid-July
  - Contact: Ellis Bird Farm, <www.ellisbirdfarm.ab.ca/events.html>
  - Goal: Awareness of bluebirds and other local wildlife
- Bug Jamboree (Lacombe)
  - Timing: early August
  - Contact: Ellis Bird Farm, <www.ellisbirdfarm.ab.ca/events.html>

- Goal: Develop awareness of, and knowledge about, insects and spiders

- Jasper Annual Wildlife Festival (Jasper)
  - Timing: late August
  - Contact: Jasper National Park, <www. jaspercanadianrockies.com, www. pc.gc.ca/eng/pn-np/ab/jasper/activ.aspx>
  - Goal: Connect to the natural ecosystems and the wildlife that depend upon them
- Waterton Wildlife Weekend (Waterton)
  - Timing: late September
  - Contact: Trail of the Great Bear, <www. trailofthegreatbear.com >
  - Goal: Experience the wonder of Waterton's native wildlife
- Crowsnest Pass Eagle Watch (Blairmore)
  - Timing: early to mid-October
  - Contact: Crowsnest Conservation Society, <www. crowsnestconservation.ca >
  - Goal: Learn about raptor identification; help with annual eagle monitoring program.
- Festival of the Eagles (Canmore)
  - Timing: mid-October
  - Contact: Town of Canmore, <www. canmore.ca/About-Canmore/Community-Celebrations/October-Festival-of-Eagles.html>
  - Goal: Celebrate the Golden Eagle migration

Appendix 3. Current wildlife festivals in Manitoba. (If you have information to update the list, please contact the authors.)

- Delta Marsh Birding Festival (Portage la Prairie)
  - Timing: May
  - Contact: Delta Marsh Bird Observatory, <www.dmbo.org/festival/>
  - Goal: Celebrate birds and promote their conservation; help local businesses through birding tourism
- Dragonfly Festival (Oak Hammock Marsh)
  - Timing: Late July
  - Contact: Oak Hammock Marsh, <www. oakhammockmarsh.ca>
  - Goal: Celebrate the importance of dragonflies in the wetland food chain
- Migration Festival (Oak Hammock Marsh)
  - Timing: Late September, early October
  - Contact: Oak Hammock Marsh, <www. oakhammockmarsh.ca>
  - Goal: Celebrate the amazing migrating birds as they head south

It is a wholesome and necessary thing for us to turn again to the earth and in the contemplation of her beauties to know of wonder and humility.
- Rachel Carson

NOTES AND LETTERS

REDISCOVERY OF STICTOTARSUS MINIPI LARSON (INSECTA: COLEOPTERA: DYTISCIDAE) IN LAKE ATHABASCA, SASKATCHEWAN.

The predaceous diving beetle species *Stictotarsus minipi* Larson (Coleoptera: Dysticidae: Hydroporinae; Fig. 1, see inside front cover, bottom) was described on the basis of a single male specimen collected from the sandy shoreline of Anne Marie Lake in southern Labrador.[1,2] The species has a number of unique features such as produced and scoop-like clypeus, distally widened protibia, and a reduced prosternal process, and narrowed hind pronotal angles which provide increased fore-body flexibility. Larson postulated that these features represent adaptations for burrowing in loose sand along the wave-washed shorelines of larger lakes.[1]

A second specimen was collected in August 2000 on the south shore of Lake Athabasca, Athabasca Sand Dunes Provincial Wilderness Park, SK (G. Hutchings, pers. comm.). The specimen was found clinging to a stick on the sandy beach. In July 2004, Gordon Hutchings and I returned to Lake Athabasca Sand Dunes Park, where many specimens were collected in shallow water near the shore as well as in beach lagoons. The water beetle *Oreodytes laevis* Kirby (Coleoptera: Dytiscidae) was a co-occurring species, as it was in its type locality.[1]

Larson postulated that *S. minipi* may have a wide distribution on sandy lake shores across the boreal region of North America.[1] However, the record from Lake Athabasca also raises the possibility that the range could be disjunct, with isolated populations in sandy areas of south-central Labrador and in the Athabasca sand dune complex of northern Saskatchewan and Alberta. The sand-associated tiger beetle *Cicindela limbata hyperborea* Wallis (Coleoptera: Carabidae; Fig. 2, see inside front cover, bottom) apparently has such a disjunct distribution, with a big gap occurring between northern Saskatchewan and southern Labrador. It has been postulated that these two populations are specifically distinct based on colour pattern, but there seems to be no grounds for this separation, as similar colour patterns occur in both areas.

An interesting question for biogeographers is whether this disjunction in the range of these sand specialists is real, due to the rarity or lack of suitable sandy habitat in intermediate areas? Or is it the result of inadequate collecting in boreal Canada? Might these be members of a larger sand-dwelling community with a similar distribution?

1. Larson DJ (1991) A new species of *Potomonectes* Zimmerman (Coleoptera: Dytiscidae) from Labrador. *The Coleopterist's Bulletin* 45:280-284.

2. Larson DJ, Alarie Y, Roughley RE (2000) The predaceous diving beetles (Coleoptera: Dytiscidae) of the Nearctic Region, with emphasis on the fauna of Canada and Alaska. NRC Research Press, Ottawa, ON.

- Ronald R. Hooper†, Royal Saskatchewan Museum, Regina, SK

The Nature Saskatchewan Fall Meet 2010 took place in Indian Head, SK. A number or awards were presented. Pictured here are several of the recipients:

1. 2010 Scholarship Award winner, Allison Henderson, with President Lorne Scott
2. Two Volunteer-of-the-Year award winners, Joan and Walter Farquharson. (The other winners, Martha and Wally Karau were not able to attend the meeting.)
3. Long-term Service award winner J. Frank Roy
4. Conservation Award winner Clem Millar and his wife Arlene
5. Larry Morgotch Photo Competition winner, Ron Jensen

6–8. New "Fellows": 6) Jacqueline Bolton, 7) Dr. Yvonne Cuttle, 8) Alan Smith

All photos by Allen McGratten.

NATURE LIBRARY

BIRDS OF CANADA

Tyler L. Hoar, Ken De Smet, R. Wayne Campbell, and Gregory Kennedy. 2010. Lone Pine Publishing, Edmonton, AB. Hardcover ISBN: 978-1-55105-603-6. 528 pages. 15 × 22.9 cm.

The Lone Pine *Birds of Canada* provides an account of 451 commonly occurring Canadian species as well as an appendix of 39 rare and accidental species. The book organizes commonly occurring species according to a standard sequence of evolutionary descent, as well as 23 different page-colour groupings. The top margins of the pages are uniquely coloured based on these groupings and are labelled by the group of birds represented. A corresponding coloured tab on the outside margin of each page is linked to the contents page, and to the back cover for quick referencing. All 451 species are presented in a reference guide section in the beginning of the book, which provides a small illustration, common name, page number, and corresponding group colour.

The Introduction has some very good sections on where to bird in Canada and ways to get involved in birding. The authors highlight some of the top places to bird in Saskatchewan and suggest a few that are less well known. The Introduction describes migration, classifications of birds, techniques of birding, and ways to attract birds to bird feeders or nest boxes. The last pages of the Introduction provide a detailed description for the species account template contained within the book, which I found to be very helpful. Although the book provides a good and useful diagram illustrating bird topography, it is unfortunately hidden in the back of the book in the Glossary, rather than in the Introduction.

Each species account has a large and detailed full-colour illustration accompanied by a colour photo in the bottom corner of each page along with a seasonal distribution map. The illustrations can include breeding and non-breeding plumage, occasional in-flight perspectives, as well as differences between sexes. However, some accounts had incomplete representations of different morphs for certain species, such as the ferruginous hawk (*Buteo regalis*). Most of the illustrations are placed near the outer margin of the page, which makes them easy to find while flipping through pages. Each species account has a brief overview describing interesting facts, unique identifying features for the species, unique behaviours, and conservation concerns. The main section of each account covers identification, size, habitat, nesting, feeding, and similar species.

The identification section, when appropriate, describes differences between adult, immature, and juvenile plumages, or between females and males. One criticism is that the descriptions can be moderately technical for beginners. For example, the species account for the chestnut-collared longspur (*Calcarius ornatus*) describes this bird as having a "chestnut nape" and "...black central and terminal feathers". The words 'nape' and 'terminal' were not listed in the Glossary, nor where they mapped on the bird diagram. This may make interpretation of the descriptions somewhat more difficult for novice birders.

The size, habitat, nesting, feeding, and voice sections provide the necessary details required for most birding activities. The sizes describe approximate bill-to-tail length and wingspan in metric measurements. The habitat section provides details on breeding habitat and occasionally migration or wintering habitat. The habitat descriptions are generally succinct and accurate, although some species have more specific details than others. The nesting section provides a concise overview of nest location or structure, as well as clutch size and incubation, while the feeding section addresses all food habits across the spectrum of birds. The voice section was unique in its attempt to describe behaviours associated with songs, calls, or alarms. Some of the song descriptions were useful, while others did not provide an accurate representation of the song. The diversity of calls made by a species was limited for some species. For example, the piping plover (*Charadrius melodus*) could be represented by more than "a clear whistled peep peep peep lo". The section on similar species does an excellent job of identifying commonly misidentified species, as well as providing key differences and page numbers for those species.

The most similar book available to the Lone Pine *Birds of Canada* is a volume of the same title published by Dorling–Kindersley (DK),[1] which has 435 full-page profiles of commonly occurring species within Canada along with shortened profiles of rare or vagrant species. The DK book presents species with full-colour enhanced photos along with key identification features listed on the photographs. Extra details offered by this publication include taxonomic classifications from order to species, descriptions and diagrams of flight patterns, weight, lifespan, and conservation status. However, this book is not suitable as a field guide, as it is much larger than the Lone Pine edition.

In comparison, the Lone Pine *Birds of Canada* appears to be superior in writings of overviews for species accounts. I found more unique details available about birds, such as "...nomadic" tendencies of short-eared owls (*Asio flammeus*), or the recent nesting of piping plovers on the "Canadian side of the Great Lakes". However, I think the dense overviews restrict the book's ability to be used as a field guide, with no key identifying features for birds being identified with the illustrations. The Lone Pine *Birds of Canada* provides an easily accessible habitat section, whereas the DK book does not. Lastly, the photographs in the Lone Pine edition are larger and of higher quality.

The Lone Pine *Birds of Canada* has the appearance of a field guide but is limited due to its size and identification sections. It does provide informative species accounts with well written narratives and generous full-colour illustrations. This book is well suited for amateur birders as a potential home or vehicle guide to complement your current field guide. The book is also well suited as an education tool in classrooms or libraries for those interested in learning more about birds. I would recommend this book to birders for the information contained within the book and the species accounts as well as the detailed illustrations. I would suggest the Lone Pine *Birds of Canada* as a home guide to life history of Canadian bird species. However, as a home guide for Canadian bird identification, I prefer the DK *Birds of Canada*, which is typically sold at the same retail price.

1. Bird DM (consultant ed) (2010) Birds of Canada. Dorling–Kindersley, Toronto, ON

- Reviewed by Joseph D. Kotlar, E-mail: <joseph_kotlar@yahoo.ca>

GRASSHOPPER IDENTIFICATION AND CONTROL METHODS TO PROTECT CROPS AND THE ENVIRONMENT

Dan L. Johnson. 2008. Published by the Saskatchewan Pulse Growers, and Agriculture and Agri-Food Canada, Pesticide Risk Reduction Program, Pest Management Centre, Ottawa. 42 pp.

To spray or not to spray? That is the question Dan Johnson tries to help farmers decide when they find grasshoppers in their pulse crops.

Through the use of photographs for identification of grasshopper species, descriptions of life history and biology, and general assessments of the potential of various grasshopper species to damage a crop, the author helps the pulse farmer evaluate the potential of a grasshopper infestation to damage his crop and his need to take control action. Although this publication is primarily a management tool, it is also an introduction to the surprisingly diverse field of grasshopper biology.

The prairies are "blessed" with a greater variety of true grasshoppers (approximately 80 species, members of the family Acrididae, the short-horned grasshoppers) than comparable regions of Canada such as British Columbia or Ontario. Prairie people are aware of the pivotal role grasshoppers play in their environment, and may even take pride in their grasshoppers, whether it be shown as fear from the devastation of a pestilence, or as the subject of legend and humour. However, Johnson shows us that the general concept of "grasshoppers" is actually too broad to be very useful. There are many different species of grasshoppers, and for each, several factors such as the developmental stage, habitat, and behaviour must be considered when talking about its potential for crop damage.

Only three of the 80 or so species of true grasshoppers that occur on the prairie are serious pests of pulse crops. Another seven species are ranked as having low pest status (although they may be serious pests of grasses), and the remainder of the fauna is considered neutral or beneficial. The concept of a beneficial grasshopper may sound surprising, but a number of species are specialists that feed on only one or a small group of plants (usually those that we would consider weedy species). Other grasshopper species occur on land that is agriculturally marginal or unsuitable, or they almost constantly occur in low enough numbers that they never pose a pest problem.

There are a few simple rules that can quickly identify the majority of non-pest species. A grasshopper is not a pulse pest if any of these conditions apply: adults occur in early spring before June; the hind wings are distinctly coloured with yellow, red, dark blue, or black; the adult grasshopper sings, clacks, or clatters either in flight or while sitting on the ground; the face in profile is pushed in (slant-faced) so that the bases of the antennae occur in front of the level of the mouth; and/or there is no distinct bump or spur ("Adam's apple"- like structure) between the bases of the front legs (as one exception, the range grasshopper

Melanoplus *sp., possibly a fourth-instar nymph of Bruner's spur-throat grasshopper* (M. bruneri). *Harvey Schmidt*

Camnula pellucida is considered of low pest status).

This book will no doubt be very useful to the pulse grower who would like to make a quick assessment of whether a grasshopper problem is developing. But it also has a wider role in introducing the general public to an unexpectedly diverse group of usually taken-for-granted insects. Besides the economic rewards of learning to identify grasshoppers, there are the satisfactions and surprises of learning about the habitat selection, feeding preferences, and behavioural peculiarities of these insects. This book is a fine introduction into this world. For those stimulated to deeper studies of grasshoppers, two very useful books are available: Vickery & Kevan (1985)[1] and Capinera et al. (2004).[2]

The photographs in the book show the array of forms, colours, and patterns displayed by prairie grasshoppers. This may be an inspiration for other naturalist photographers. Grasshopper photography has many rewards, especially in terms of learning the diverse biology of these insects as well as challenges in capturing the bright colors (often confined to the legs and wings and usually hidden from prying eyes and camera lenses) and behavioural displays.

The practical lesson Johnson provides is that only after we have determined the species and its general potential to cause damage to a given type of crop, its developmental stage, and its abundance, should we make the decision - let us spray.

1. Vickery VR, Kevan DKM (1985) The Insects and Arachnids of Canada, Part 14. The Grasshoppers, Crickets, and Related Insects of Canada and Adjacent Regions. Research Branch, Agriculture Canada, Publication 1777. Ottawa, ON.

2. Capinera JL, Scott RD, Walker TJ (2004) Field Guide to Grasshoppers, Katydids, and Crickets of the United States. Cornell University Press, Ithaca, NY.

- *Reviewed by David Larson, PO Box 56, Maple Creek, SK S0N 1N0; E-mail: <dmlarson@sasktel.net>*

Editors' note: For an on-line version of this book, see <http://www.saskpulse.com/media/pdfs/2008_Grasshopper_Identification_Booklet.pdf>.

MYSTERY PHOTO

ANSWER TO THE SEPTEMBER 2010 MYSTERY PHOTO

This fungus, submitted by Joseph Kotlar, apparently has our readers stumped (no pun intended). As we did not receive any potential solutions, we will leave this mystery open to further speculation...

DECEMBER 2010 MYSTERY PHOTO

Harvey Schmidt submitted this wintry scene (see inside back cover, bottom, for a colour version) and posed the question: How many birds can you count? (There really are birds in this photo - lots of them!)

INDEX TO VOLUME 68

2010 INDEX TO AUTHORS AND ILLUSTRATORS

Amosa, Esayas. See Peterson, Katherine

Artuso, Christian. Photos. Red Fox 22; Trio of Chimney Swifts in flight 124; Chimney Swift in flight 126; Male Lazuli Bunting, September inside back cover

__ Peter Taylor, Ken de Smet and David Raitt. Notable Records from the Manitoba Breeding Bird Atlas 2010 Season 114-123

Basu, Saikat Kumar. Cougar Tracks in Alberta [photo note] 53-54

__ Photo. Cougar tracks 53

Boys, Linda. Photo. Rose-breasted Grosbeak 116

Bugajski, Aleksandra. See Doucette, Jennifer L.

Choi, Hyeok Jae, Catherine Peters and J. Hugo Cota-Sánchez. Taxonomy of Wild Onions (*Allium*) in Saskatchewan 146-153

Clarke, Jared B. Photo. Adult Marsh Wren caught at Wascana Centre MAPS station, December back cover

__ and Bob Ewart. New Monitoring Avian Productivity and Survival (MAPS) Station Established in Wascana Centre, Regina, SK, Summer 2010 174-178

Collicut, Doug. Photo. Larval Blue-spotted Salamander 186

Cota-Sánchez, J. Hugo. See Choi, Hyeok Jae

De Smet, Ken. See Artuso, Christian

Dickson, Ross D. Sharp-shinned Hawk Monitoring at Last Mountain Regional Park, Saskatchewan 179-183

__ Photo. Immature Sharp-shinned Hawk showing nictitating membrane covering left eye, December back cover

Dolman, Teresa. *Blue Jay* Index to Volume 68, 2010 225-237

Doucette, Jennifer L. Photos. Double-crested Cormorant colony in Nut Bay, Lac La Ronge, SK 73; Double-crested Cormorant colony east of Long Island, Lac La Ronge, SK 74; Unfledged juvenile Double-crested Cormorants 74

__ Aleksandra Bugajski and Mark Duffy. Double-crested Cormorants Expand Their Breeding Range onto the Boreal Shield 71-74

Duffy, Mark. See Doucette, Jennifer L.

Epp, Henry T. Managing Environmental Uncertainty 154-163

__ Photos. Eastern parkland – Cook's Creek, MB 155; Foothills – Elbow River, AB 156

Erbilgin, Nadir. See Peterson, Katherine

Erskine, A.J. (Tony). A Query from the Distant Past – Magpies Versus "Huns", note 45

Ewart, Bob. See Clarke, Jared B.

Fargey, Pat. See Wruth, Ashley

Fisher, Ryan. Short-eared Owl [photo note] 56

__ Photos. Juvenile Great Horned Owls 49; Short-eared Owl 56; Tracks in snow made by Gray Partridge 61, 109

Fortney, Ashley. Road Mortality Survey in Southwestern Saskatchewan 95-98
__ Photos. Prairie Rattlesnake basking on a gravel road, March inside front cover; Road-killed juvenile American Badger 96
Fransden, Dan. See Somers, Christopher M.
Gosselin, Robert. Prevalence and Intensity of Endoparasitic Nematode Infestations in Adult and Juvenile Sharp-shinned Hawks 91-94
__ Photo. Nematode-infested proventriculus of adult Sharp-shinned Hawk, June inside back cover
Hecker, Kerry. Photos. Spring wetland: Lesser Snow Geese, Ross' Geese and Canada Geese during spring migration 57; December 2009 Mystery Photo (pink sludge) 61
Hewson, Shauna and William G. Watkins. Update on the Range and Distribution of Blue-spotted Salamanders in Manitoba 184-189
Hooper, Ronald R. Rediscovery of *Stictotarsus minipi* Larson (Insecta: Coleoptera: Dytiscidae) in Lake Athabasca, Saskatchewan, note 218
__ Photos. Predaceous diving beetle (*Stictotarsus minipi*) and sand-associated tiger beetle (*Cicindela limbata hyperborea*), December inside front cover
Houston, C. Stuart. In Memoriam: Mary Gilliland (1940-2010) 106-108
__ Saskatchewan's First Game Guardian: Neil Gilmour (1859-1940) 41-44
Hvenegaard, Glen T. Photo. Dan Olofson and Bob Buskas discussing nest box issues at the Camrose Purple Martin Festival in Alberta 208
__ and Nhial Tiitmamer Kur. Enhancing Conservation Benefits from Wildlife Festivals and Ecotourism Activities 208-217
Janelle, Johane. Photos. Mormon Metalmark caterpillar, March front cover, 38; Black-footed Ferret released into Grasslands National Park 135
Jansen, Delwyn J.J. Unusual Lily, note 165
Jordheim, Darryl. Unusual Lark Sparrow Nesting Site [photo note] 54-55
__ and Ruby Jordheim. Photos. Lark Sparrow nest in upturned tree stump 54; Close-up of the Lark Sparrow nest 55
Jordheim, Ruby. See Jordheim, Darryl
Kingdon, Ken. Lynx Predation on a Young Beaver, note 45-47
Kjoss, Victoria (Vicky). See Somers, Christopher (Chris) M.
Knaga, Paul. Photos. Black-footed Ferret 133; Black-footed Ferret being PIT-tag scanned 136
Koes, Rudolf. Recent Bald Eagle Breeding Range Expansion in Manitoba 24-28
__ Drawings. Bald Eagle 26, 28
Kotlar, Joseph D. Book review. Birds of Canada. HOAR, DE SMET, CAMPBELL, KENNEDY. 220-221
__ Photo. Mystery fungus 169, 224
Larson, David. Book review. Grasshopper Identification and Control Methods to Protects Crops and the Environment. JOHNSON. 222-223
Leighton, Frederick A. See Somers, Christopher M.
Lichtenwald, Lyle. 40th Anniversary of the Saskatchewan Outdoor and Environmental Education Association, note 50-52
Lywak, Laurie L. See Parker, Brian R.
Matichuk, Adam. Fishway Monitoring at the Craven Dam, Qu'Appelle River, Saskatchewan 137-145

McCulloch, Randy. Photos. Winter Weasel 52; Juvenile Rough-legged hawk 55; Winter Moose, March back cover; Cinnamon Teal, June inside back cover; Prairie Falcon 145; Black-necked Stilt 168; Great Egret near Herbert SK 178
McGratten, Allen. Photos. Nature Saskatchewan Award winners 219
McManus, Patrick. Photo. Black-footed Ferret in Grasslands National Park, September front cover
Parker, Brian R. and Laurie L. Lywak. Black-capped Chickadees and White-breasted Nuthatches Scavenge a Deer Carcass, note 47-48
__ Photos. Black-capped Chickadee landing on deer carcass (top), and removing a piece of muscle tissue from the carcass (bottom), March inside back cover
Peters, Catherine. See Choi, Hyeok Jae
Peterson, Katherine, Esayas Amosa, Shelley Prus and Nadir Erbilgin. First Caterpillar Observations of the Mormon Metalmark Butterfly in Grasslands National Park, Saskatchewan 37-40
__ Photos. Flowering host plants of the Mormon Metalmark: Branched Umbrella Plant (*Eriogonum pauciflorum*) and Rubber Rabbitbrush (*Ericameria nauseosus*), March inside front cover; Mating Mormon Metalmark butterflies 39
Pletz, Erhard (Hardy). Survival of a 'Fostered' Young Great Horned Owl, note 48-49
Pruss, Shelley. Photo. Branched Umbrella Plant with leaves eaten by Mormon Metalmark caterpillars 39
__ See Peterson, Katherine
Raitt, David. Photo. Western Tanager 116
__ See Artuso, Christian
Robson, Diana Bizecki. The Bugseeds (*Corispermum*) of the Prairie Provinces 199-207
__ Drawings. American bugseed, Hooker's bugseed, Pallas bugseed and hairy bugseed seeds 203
__ Photos. American bugseed (*Corispermum americanum*), Hooker's bugseed (*C. hookeri*) and hairy bugseed (*C. villosum*), December inside front cover; Habitat of hairy bugseed on dunes in Grand Beach Provincial Park, MB 201
Saunders, Nick. Photos. Pileated Woodpecker 2; Boreal Chickadee 3; Timber Wolf 29; River Otter 60; Sora Rail, June inside front cover
Schmidt, Harvey. Jumping Spider [photo note] 166
__ Photos. Rustic Bunting, rare visitor to Saskatchewan 20; Lacewing eggs on stalks 109, June back cover, 169; Jumping spider 166; Green Lacewing, adult and larva 169; Jumping spider, September back cover; Grasshopper (*Melanoplus* sp.) 223; December Mystery Photo 224 and December back cover
Smith, Alan R. 37th Annual Saskatchewan Christmas Mammal Count–2009 29-36
__ 68th Annual Saskatchewan Christmas Bird Count–2009 2-23
__ Photo. Sharp-shinned Hawk 179
Smith-Fargey, Karin. See Wruth, Ashley
Somers, Christopher (Chris) M. Photos. Nearly fledged juvenile American White Pelicans 76; Sub-adult Double-crested Cormorant 77; Aerial photo of colony of American White Pelicans and Double-crested Cormorants 79
__ Victoria A. Kjoss, Frederick A. Leighton and Dan Fransden. American White Pelicans and Double-crested Cormorants in Saskatchewan: Population Trends over Five Decades 75-86

Stewart, Barbara E. and Robert E.A. Stewart. Nest Site Use and Breeding Success of Chimney Swifts in St. Adolphe, MB, 2007-2009 124-132
Stewart, Robert E.A. See Stewart, Barbara E.
Taylor, Peter. Possible Breeding Northern Parulas in Central Western Manitoba, note 99-101
__ Seasonal Movements of Blue-spotted Salamanders at Pinawa, Manitoba 190-198
__ Photos. Baltimore Checkerspot butterfly, dorsal and ventral views, June inside front cover; Turtlehead (*Chelone glabra*) 87; Possible breeding habitat for Northern Parulas, with inset showing arobreal lichens 100; Blue-spotted Salamander, December front cover; Blue-spotted Salamander showing head-up posture 192
__ and A. Richard Westwood. Records of the Baltimore Checkerspot Butterfly in Manitoba 87-90
__ See Artuso, Christian
Tiitmamer Kur, Nhial. See Hvenegaard, Glen T.
Vanthuyne, Lois. Photo. Aerial photo (adapted from Google Earth©) of Last Mountain Regional Park, site of Sharp-shinned Hawk monitoring 180
Vinge, Sarah. Photo. Unusual Western Red Lily (*Lilium philadelphicum* var. *andinum*), September inside back cover
Walker, Sharon. Sandhill Cranes [photo note] 102
__ Photos. Distraction display of Sandhill Crane 102
Walley, William J. Great Blue Heron Swallows Muskrat, note 164-165
Warnock, Rob. Book review. Birds of Eastern North America: A Photographic Guide. STERRY, SMALL. 58-60
__ Book review. Birds of North America. VUILLEUMIER (editor). 103-104
__ Book review. Birds of Western North America: a Photographic Guide. STERRY, SMALL. 58-60
__ Book review. Saskatchewan Wild: A Wildlife Photographic Journey. KARPAN, KARPAN. 167-168
Watkins, William G. See Hewson, Shauna
Weidl, Don. In Memoriam: David Chaskavich (1953-2010) 105-106
Westwood, A. Richard. See Taylor, Peter
Wruth, Ashley, Karin Smith-Fargey and Pat Fargey. Black-footed Ferret Reintroduction in Grasslands National Park, Saskatchewan 133-136

2010 SUBJECT INDEX

Amphibians
Counts, Surveys and Lists
Seasonal Movements of Blue-spotted Salamanders at Pinawa, Manitoba TAYLOR 190-198
Update on the Range and Distribution of Blue-spotted Salamanders in Manitoba HEWSON, WATKINS 184-189

Distribution
Update on the Range and Distribution of Blue-spotted Salamanders in Manitoba HEWSON, WATKINS 184-189
Particular Species
Salamander, Blue-spotted
Seasonal Movements of Blue-spotted Salamanders at Pinawa, Manitoba TAYLOR 190-198
Update on the Range and Distribution of Blue-spotted Salamanders in Manitoba HEWSON, WATKINS 184-189
Seasonal Movements
Seasonal Movements of Blue-spotted Salamanders at Pinawa, Manitoba TAYLOR 190-198

Arachnids
Particular Species
Spider, Jumping
Jumping Spider [photo note] SCHMIDT 166

Birds
Associations
A Query from the Distant Past – Magpies Versus "Huns" ERSKINE 45
Behaviour
Sandhill Cranes [photo note] WALKER 102
Breeding Records and Distribution
Double-crested Cormorants Expand Their Breeding Range Onto the Boreal Shield DOUCETTE, BUGAJSKI, DUFFY 71-74
Notable Records from the Manitoba Breeding Bird Atlas 2010 Season ARTUSO, TAYLOR, DE SMET, RAITT 114-123
Possible Breeding Northern Parulas in Central Western Manitoba, TAYLOR 99-101
Recent Bald Eagle Breeding Range Expansion in Manitoba KOES 24-28
Counts, Surveys and Lists
68th Annual Saskatchewan Christmas Bird Count–2009 SMITH 2-23
American White Pelicans and Double-crested Cormorants in Saskatchewan: Population Trends over Five Decades SOMERS, KJOSS, LEIGHTON, FRANSDEN 75-86
Nest Site Use and Breeding Success of Chimney Swifts in St. Adolphe, MB, 2007-2009 STEWART, STEWART 124-132
New Monitoring Avian Productivity and Survival (MAPS) Station Established in Wascana Centre, Regina, SK, Summer 2010 CLARKE, EWART 174-178
Notable Records from the Manitoba Breeding Bird Atlas 2010 Season ARTUSO, TAYLOR, DE SMET, RAITT 114-123
Road Mortality Survey in Southwestern Saskatchewan FORTNEY 95-98
Sharp-shinned Hawk Monitoring at Last Mountain Regional Park, Saskatchewan DICKSON 179-183
Diet and Feeding
Black-capped Chickadees and White-breasted Nuthatches Scavenge a Deer Carcass PARKER, LYWAK 47-48
Great Blue Heron Swallows Muskrat WALLEY 164-165
Mortality
Road Mortality Survey in Southwestern Saskatchewan FORTNEY 95-98

Nesting Phenology
Nest Site Use and Breeding Success of Chimney Swifts in St. Adolphe, MB, 2007-2009 STEWART, STEWART 124-132
Nests
Unusual Lark Sparrow Nesting Site JORDHEIM 54-55
Numbers
American White Pelicans and Double-crested Cormorants in Saskatchewan: Population Trends over Five Decades SOMERS, KJOSS, LEIGHTON, FRANSDEN 75-86
New Monitoring Avian Productivity and Survival (MAPS) Station Established in Wascana Centre, Regina, SK, Summer 2010 CLARKE, EWART 174-178
Sharp-shinned Hawk Monitoring at Last Mountain Regional Park, Saskatchewan DICKSON 179-183
Parasites
Prevalence and Intensity of Endoparasitic Nematode Infestations in Adult and Juvenile Sharp-shinned Hawks GOSSELIN 91-94
Particular Species
Chickadee, Black-capped
Black-capped Chickadees and White-breasted Nuthatches Scavenge a Deer Carcass PARKER, LYWAK 47-48
Cormorant, Double-crested
American White Pelicans and Double-crested Cormorants in Saskatchewan: Population Trends over Five Decades SOMERS, KJOSS, LEIGHTON, FRANSDEN 75-86
Double-crested Cormorants Expand Their Breeding Range Onto the Boreal Shield DOUCETTE, BUGAJSKI, DUFFY 71-74
Crane, Sandhill
Sandhill Cranes [photo note] WALKER 102
Eagle, Bald
Recent Bald Eagle Breeding Range Expansion in Manitoba KOES 24-28
Hawk, Sharp-shinned
Prevalence and Intensity of Endoparasitic Nematode Infestations in Adult and Juvenile Sharp-shinned Hawks GOSSELIN 91-94
Sharp-shinned Hawk Monitoring at Last Mountain Regional Park, Saskatchewan DICKSON 179-183
Heron, Great Blue
Great Blue Heron Swallows Muskrat WALLEY 164-165
Magpie, Black-billed
A Query from the Distant Past – Magpies Versus "Huns" ERSKINE 45
Nuthatch, White-breasted
Black-capped Chickadees and White-breasted Nuthatches Scavenge a Deer Carcass PARKER, LYWAK 47-48
Owl, Great Horned
Survival of a 'Fostered' Young Great Horned Owl PLETZ 48-49
Owl, Short-eared
Short-eared Owl FISHER 56
Partridge, Gray
A Query from the Distant Past – Magpies Versus "Huns" ERSKINE 45
Parula, Northern
Possible Breeding Northern Parulas in Central Western Manitoba, TAYLOR 99-101

Pelican, American White
American White Pelicans and Double-crested Cormorants in Saskatchewan: Population Trends over Five Decades SOMERS, KJOSS, LEIGHTON, FRANSDEN 75-86
Sparrow, Lark
Unusual Lark Sparrow Nesting Site JORDHEIM 54-55
Swift, Chimney
Nest Site Use and Breeding Success of Chimney Swifts in St. Adolphe, MB, 2007-2009 STEWART, STEWART 124-132
Rarities
Notable Records from the Manitoba Breeding Bird Atlas 2010 Season ARTUSO, TAYLOR, DE SMET, RAITT 114-123
Rescue and Rehabilitation
Survival of a 'Fostered' Young Great Horned Owl PLETZ 48-49

Conservation
Awareness-promoting Activities
40th Anniversary of the Saskatchewan Outdoor and Environmental Education Association LICHTENWALD 50-52
Enhancing Conservation Benefits from Wildlife Festivals and Ecotourism Activities HVENEGAARD, TIITMAMER KUR 208-217
Update on the Range and Distribution of Blue-spotted Salamanders in Manitoba HEWSON, WATKINS 184-189
Ecosystems
Managing Environmental Uncertainty EPP 154-163
Endangered Species
Black-footed Ferret Reintroduction in Grasslands National Park, Saskatchewan WRUTH, SMITH-FARGEY, FARGEY 133-136

Fish
Counts, Surveys and Lists
Fishway Monitoring at the Craven Dam, Qu'Appelle River, Saskatchewan MATICHUK 137-145
Numbers
Fishway Monitoring at the Craven Dam, Qu'Appelle River, Saskatchewan MATICHUK 137-145

Humans
Awareness of Nature & Conservation
40th Anniversary of the Saskatchewan Outdoor and Environmental Education Association LICHTENWALD 50-52
Enhancing Conservation Benefits from Wildlife Festivals and Ecotourism Activities HVENEGAARD, TIITMAMER KUR 208-217
Impact on Environment
Road Mortality Survey in Southwestern Saskatchewan FORTNEY 95-98

In Memoriam
David Chaskavich (1953-2010) WEIDL 105-106
Mary Gilliland (1940-2010) HOUSTON 106-108

Insects
Behaviour
Records of the Baltimore Checkerspot Butterfly in Manitoba TAYLOR, WESTWOOD 87-90
Counts, Surveys and Lists
Records of the Baltimore Checkerspot Butterfly in Manitoba TAYLOR, WESTWOOD 87-90
Diet and Feeding
First Caterpillar Observations of the Mormon Metalmark Butterfly in Grasslands National Park, Saskatchewan PETERSON, AMOSA, PRUSS, ERBILGIN 37-40
Records of the Baltimore Checkerspot Butterfly in Manitoba TAYLOR, WESTWOOD 87-90
Particular Taxa
Beetles (Coleoptera)
Diving Beetle, Predaceous (*Stictotarsus minipi*)
Rediscovery of *Stictotarsus minipi* Larson (Insecta: Coleoptera: Dytiscidae) in Lake Athabasca, Saskatchewan HOOPER 218
Butterflies & Moths (Lepidoptera)
Checkerspot, Baltimore
Records of the Baltimore Checkerspot Butterfly in Manitoba TAYLOR, WESTWOOD 87-90
Metalmark, Mormon
First Caterpillar Observations of the Mormon Metalmark Butterfly in Grasslands National Park, Saskatchewan PETERSON, AMOSA, PRUSS, ERBILGIN 37-40
Rarities
First Caterpillar Observations of the Mormon Metalmark Butterfly in Grasslands National Park, Saskatchewan PETERSON, AMOSA, PRUSS, ERBILGIN 37-40
Rediscovery of *Stictotarsus minipi* Larson (Insecta: Coleoptera: Dytiscidae) in Lake Athabasca, Saskatchewan HOOPER 218
Records and Distribution
Records of the Baltimore Checkerspot Butterfly in Manitoba TAYLOR, WESTWOOD 87-90

Mammals
Counts, Surveys and Lists
37th Annual Saskatchewan Christmas Mammal Count–2009 SMITH 29-36
Road Mortality Survey in Southwestern Saskatchewan FORTNEY 95-98
Management
Black-footed Ferret Reintroduction in Grasslands National Park, Saskatchewan WRUTH, SMITH-FARGEY, FARGEY 133-136
Mortality
Road Mortality Survey in Southwestern Saskatchewan FORTNEY 95-98
Particular Species
Beaver, American
Lynx Predation on a Young Beaver KINGDON 45-47
Cougar [Puma]
Cougar Tracks in Alberta BASU 53-54
Ferret, Black-footed
Black-footed Ferret Reintroduction in Grasslands National Park, Saskatchewan WRUTH, SMITH-FARGEY, FARGEY 133-136

Lynx, Canada
Lynx Predation on a Young Beaver KINGDON 45-47
Muskrat
Great Blue Heron Swallows Muskrat WALLEY 164-165
Predators and Prey
Lynx Predation on a Young Beaver KINGDON 45-47

Manitoba
Pinawa
Seasonal Movements of Blue-spotted Salamanders at Pinawa, Manitoba TAYLOR 190-198
St. Adolphe
Nest Site Use and Breeding Success of Chimney Swifts in St. Adolphe, MB, 2007-2009 STEWART, STEWART 124-132

Mystery Photos
Answers to: December 2009 Mystery Photo 61; March 2010 Mystery Photo 109; June 2010 Mystery Photo 169; September 2010 Mystery Photo 224

Nature Library
Birds of Canada. HOAR, DE SMET, CAMPBELL, KENNEDY, Book reviewed by KOTLAR 220-221
Birds of Eastern North America: A Photographic Guide. STERRY, SMALL. Book reviewed by WARNOCK 58-60
Birds of North America. VUILLEUMIER (ed.). Book reviewed by WARNOCK 103-104
Birds of Western North America: A Photographic Guide. STERRY, SMALL. Book reviewed by WARNOCK 58-60
Grasshopper Identification and Control Methods to Protects Crops and the Environment. JOHNSON. Book reviewed by LARSON 222-223
Saskatchewan Wild: A Wildlife Photographic Journey. KARPAN, KARPAN. Book reviewed by WARNOCK 167-168

Nature Saskatchewan
Awards and Honours
Conservation Award 219
Fellows Award 219
Larry Morgotch Memorial Award 219
Long-term Service Award 219
Natural History Scholarship 219
Volunteer of the Year Award 219
Publications - *Blue Jay*
Revised Guidelines for Authors 66-70

People and Societies
Bolton, Jacqueline
Nature Saskatchewan 2010 Fellows Award 219
Chaskavich, David
In Memoriam: David Chaskavich (1953-2010) WEIDL 105-106
Cuttle, Yvonne
Nature Saskatchewan 2010 Fellows Award 219
Farquharson, Joan and Walter

Nature Saskatchewan 2010 Volunteer of the Year Award 219
Gilliland, Mary
In Memoriam: Mary Gilliland (1940-2010) HOUSTON 106-108
Gilmour, Neil
Saskatchewan's First Game Guardian: Neil Gilmour, 1859-1940 HOUSTON 41-44
Henderson, Allison
Nature Saskatchewan 2010 Natural History Scholarship 219
Jensen, Ron
Nature Saskatchewan 2010 Larry Morgotch Memorial Photographic Award 219
Karau, Martha and Wally
Nature Saskatchewan 2010 Volunteer of the Year Award 219
Millar, Clem
Nature Saskatchewan 2010 Conservation Award 219
Roy, J. Frank
Nature Saskatchewan 2010 Long-term Service Award 219
Saskatchewan Outdoor and Environmental Education Association
40th Anniversary of the Saskatchewan Outdoor and Environmental Education Association LICHTENWALD 50-52
Smith, Alan R.
Nature Saskatchewan 2010 Fellows Award 219

Plants
Counts, Surveys and Lists
Taxonomy of Wild Onions (*Allium*) in Saskatchewan CHOI, PETERS, COTA-SÁNCHEZ 146-153
Description and Identification
Taxonomy of Wild Onions (*Allium*) in Saskatchewan CHOI, PETERS, COTA-SÁNCHEZ 146-153
The Bugseeds (*Corispermum*) of the Prairie Provinces ROBSON 199-207
Life History
The Bugseeds (*Corispermum*) of the Prairie Provinces ROBSON 199-207
Particular Taxa
Bugseeds (*Corispermum* spp.)
The Bugseeds (*Corispermum*) of the Prairie Provinces ROBSON 199-207
Lily, Western Red (*Lilium philadelphicum*)
Unusual Lily JANSEN 165
Onions (*Allium* spp.)
Taxonomy of Wild Onions (*Allium*) in Saskatchewan CHOI, PETERS, COTA-SÁNCHEZ 146-153

Saskatchewan
Craven Dam, Qu'Appelle River
Fishway Monitoring at the Craven Dam, Qu'Appelle River, Saskatchewan MATICHUK 137-145
Grasslands National Park
Black-footed Ferret Reintroduction in Grasslands National Park, Saskatchewan WRUTH, SMITH-FARGEY, FARGEY 133-136
First Caterpillar Observations of the Mormon Metalmark Butterfly in Grasslands National Park, Saskatchewan PETERSON, AMOSA, PRUSS, ERBILGIN 37-40
Lake Athabasca
Rediscovery of *Stictotarsus minipi* Larson (Insecta: Coleoptera: Dytiscidae) in Lake Athabasca, Saskatchewan HOOPER 218

Last Mountain Regional Park
Sharp-shinned Hawk Monitoring at Last Mountain Regional Park, Saskatchewan DICKSON 179-183
Regina
New Monitoring Avian Productivity and Survival (MAPS) Station Established in Wascana Centre, Regina, SK, Summer 2010 CLARKE, EWART 174-178

2010 ILLUSTRATION INDEX

All illustrations are photographs unless otherwise indicated

Amphibians
Salamander, Blue-spotted: TAYLOR December front cover; larva, COLLICUT 186; showing head-up posture, TAYLOR 192
Arachnids
Spider, Jumping: SCHMIDT 166, September back cover
Bird Nests and Eggs
Sparrow, Lark: nest in upturned tree stump, JORDHEIM, JORDHEIM 54; close-up of nest, JORDHEIM, JORDEIM 55
Birds
Bunting, Lazuli: male, ARTUSO September inside back cover
Bunting, Rustic: SCHMIDT 20
Chickadee, Black-capped: landing on deer carcass (top) and removing piece of muscle tissue from carcass (bottom), PARKER March inside back cover
Chickadee, Boreal: SAUNDERS 3
Cormorant, Double-crested: colonies, DOUCETTE June front cover, 73, 74; unfledged juveniles, DOUCETTE 74; sub-adult, SOMERS 77; aerial view of colony, SOMERS 79
Crane, Sandhill: distraction display, WALKER 102
Eagle, Bald: (drawings) KOES 26, 28
Egret, Great: near Herbert SK, McCULLOCH 178
Falcon, Prairie: McCULLOCH 145
Geese: at Stalwart National Wildlife Area, SK, HECKER 57
Grosbeak, Rose-breasted: BOYS 116
Hawk, Rough-legged: juvenile, McCULLOCH 55
Hawk, Sharp-shinned: nematode-infested proventriculus, GOSSELIN June inside back cover; SMITH 179; immature showing nictitating membrane covering left eye, DICKSON December back cover
Owl, Great Horned: juveniles, FISHER 49
Owl, Short-eared: FISHER 56
Partridge, Gray: tracks in snow, FISHER 61,109
Pelican, American White: nearly fledged juveniles, SOMERS 76; aerial view of colony, SOMERS 79
Sora: SAUNDERS June inside front cover
Sparrow, Lark: on nest, JORDHEIM, JORDHEIM 55
Stilt, Black-necked: McCULLOCH 168

Swift, Chimney: trio in flight, ARTUSO 124; single bird in flight, ARTUSO 126
Tanager, Western: RAITT 116
Teal, Cinnamon: McCULLOCH June inside back cover
Woodpecker, Pileated: SAUNDERS 2
Wren, Marsh: caught at Wascana Centre MAPS station, CLARKE December back cover

Fish

Buffalo, Bigmouth: 143
Quillback: 143

Fungi

Mystery fungus: KOTLAR 169, 224

Habitat and Scenery

Foothills: Elbow River, AB, EPP 156
Last Mountain Regional Park and bird observatory banding station: aerial photo (adapted from Google Earth©) of the site of Sharp-shinned Hawk monitoring, VANTHUYNE 180
Parkland: Cook's Creek, MB, EPP 155
Pond 'sludge': HECKER 61
Sand dunes: hairy bugseed habitat in Grand Beach Provincial Park, MB, ROBSON 201
Possible breeding habitat for Northern Parulas: TAYLOR 100
Wascana Centre, Regina: aerial photo showing locations of MAPS net locations, 175
Wetland: Stalwart National Wildlife Area, SK, HECKER 57
Wintry scene: with camouflaged birds, SCHMIDT 224 and December back cover

Insects

Beetles (Coleoptera)
Diving beetle, predaceous (*Stictotarsus minipi*): HOOPER December inside front cover
Tiger beetle (*Cicindela limbata hyperborea*): HOOPER December inside front cover
Butterflies & Moths (Lepidoptera)
Checkerspot, Baltimore: dorsal and ventral views, TAYLOR June inside front cover
Metalmark, Mormon: caterpillar, JANELLE March front cover, 38; mating adults, PETERSON 39
Grasshoppers & Crickets (Orthoptera)
Grasshopper: *Melanoplus* sp., SCHMIDT 223
Lacewings (Neuroptera)
Lacewing: eggs on stalks, SCHMIDT 109, June back cover, 169; adult and larva, SCHMIDT 169

Mammals

Badger, American: road-killed, FORTNEY 96
Beaver, American: dentition showing eruption of premolars, 46
Cougar (Puma): tracks, BASU 53
Ferret, Black-footed: McMANUS September front cover; KNAGA 133; being released, JANELLE 135; being PIT-tag scanned, KNAGA 136
Fox, Red: ARTUSO 22
Moose: winter, McCULLOCH March back cover
Otter, River: SAUNDERS 60
Weasel: winter, McCULLOCH 52
Wolf, Timber (Gray): SAUNDERS 29

People and Societies

Bolton, Jacqueline: recipient of Nature Saskatchewan's 2010 Fellows Award, McGRATTEN 219
Chaskavich, David: 105

219
Farquharson, Joan and Walter: recipients of Nature Saskatchewan's 2010 Volunteer of the Year Awards, McGRATTEN 219
Gilliland, Mary: 106
Gilmour, Neil: 41
Henderson, Allison: recipient of Nature Saskatchewan's 2010 Natural History Scholarship, McGRATTEN 219
Jensen, Ron: recipient of Nature Saskatchewan's 2010 Larry Morgotch Memorial Photographic Award, McGRATTEN 219
Millar, Clem (with wife Arlene): recipient of Nature Saskatchewan's 2010 Conservation Award, McGRATTEN 219
Purple Martin Festival (Camrose, AB): Dan Olofson and Bob Buskas discussing nest box issues, HVENEGAARD 208
Roy, J. Frank: recipient of Nature Saskatchewan's 2010 Long-term Service Award, McGRATTEN 219
Scott, Lorne: Nature Saskatchewan President, McGRATTEN 219
Smith, Alan: recipient of Nature Saskatchewan's 2010 Fellows Award, McGRATTEN 219

Plants

Bugseeds (*Corispermum* spp.): American bugseed (*C, americanum*), Hooker's bugseed (*C. hookeri*) and hairy bugseed (*C. villosum*), ROBSON December inside front cover; American bugseed, Hooker's bugseed, Pallas bugseed and hairy bugseed seeds (drawings), ROBSON 203
Lily, Western Red (*Lilium philadelphicum* var. *andinum*): unusual form, VINGE September inside back cover
Onions: plant habit and inflorescence of *Allium schoenoprasum*, *A. textile*, *A. cernuum*, *A. stellatum*, September inside front cover
Rabbitbrush, Rubber (*Ericameria nauseosus*): PETERSON March inside front cover
Turtlehead (*Chelone glabra*): TAYLOR 87
Umbrella Plant, Branched (*Eriogonum pauciflorum*): PETERSON March inside front cover; with leaves eaten by Mormon Metalmark caterpillars, PRUSS 39

Reptiles

Rattlesnake, Prairie: basking on gravel road, FORTNEY March inside front cover

Blue Jay, founded in 1942 by Isabel M. Priestly, is a journal of natural history and conservation for Saskatchewan and adjacent regions. It is published quarterly by **Nature Saskatchewan, 206-1860 Lorne Street, Regina, Saskatchewan S4P 2L7.**

CN ISSN 0006-5099

Editors: Vicky Kjoss and Chris Somers, 3426 Clover Pl., Regina, SK S4V 1J1,
Email: kjoss@sasktel.net
Formatting: Carla Windl, Email: cwindl@accesscomm.ca, 306-789-7840
Associate Editors: Mark Brigham, Marlene Evans, Vernon Harms, Stuart Houston, Josef Schmutz, Carol Scott.

EDITORIAL INFORMATION: Blue Jay welcomes all submissions, preferably by E-mail (although hand-written or typed manuscripts will be considered), polished or in need of some editorial assistance. All items for publication should be sent to the editors electronically by E-mail or on CD, or hard copies (in duplicate) may be sent by mail to the editors at the address above. Electronic submissions should only be submitted in Microsoft Word. Submission deadlines are 1 January (for the March issue), 1 April (for June), 1 July (for September), and 1 October (for December). For detailed information, see the "Guidelines for Authors" in Blue Jay Vol. 68 (2). Diether Peschken abstracts Blue Jay for Recent Ornithological Literature. Titles of Blue Jay articles are listed in BIOSIS.

Common and scientific (Latin) names are used for all species. Common bird names follow the Checklist of North American birds by the American Ornithologists' Union (7th edition, 1998); mammal names: Mammal Species of the World by Wilson & Reeder; butterfly names: The Butterflies of Canada by Layberry et al.;and names of reptiles and amphibians follow Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with comments Regarding Confidence in our Understanding, Sixth Edition, by The Committee on Standard English and Scientific Names (Brian I. Crother, Chair) (2008).

Photographs may be submitted as digital images or as prints. For the best quality reproduction on paper, high-resolution (≥600 DPI) images are required, although in some cases, lower-resolution images may provide sufficient quality. Digital images can be sent by E-mail directly to the editors, or if the files are very large, they should be put on a CD and mailed to the editors at the address above.

Although Nature Saskatchewan will make every effort to return prints to you, we recommend that you make a copy in case your items are lost in the mail. We encourage submission of photographic material with articles and welcome colour photos for Blue Jay covers.

Any material printed in Blue Jay may be reprinted for non-commercial purposes, without permission, but credit lines are both appreciated and good etiquette. Use of photographs and poetry requires permission from the photographer/author.

REPRINTS: a maximum of five reprints is available to authors free of charge for each article. Authors wishing to receive reprints should send their request to the Nature Saskatchewan office as soon as they receive notice that their article is accepted for publication.

SUBSCRIPTIONS: Subscription to Blue Jay is one of the benefits of membership in Nature Saskatchewan. A membership application form is included on the last page of each issue. Send all renewals, new memberships, donations and changes of address to Nature Saskatchewan (address at top).

Bulk subscription orders (minimum of five to one address) are available to society members and educational institutions at the rate of $15 (Can.) for the first subscription and $13 for each additional one. Outside Canada, fees are $18 (Can.). We do not collect GST on memberships or subscriptions.

Printed by Administration Centre Printing Services, Regina, SK.

THIS ORGANIZATION RECEIVES FUNDING FROM

NATURE SASKATCHEWAN

206-1860 Lorne Street, Regina, Saskatchewan S4P 2L7
Phone: (306) 780-9273 or
toll free 800-667-4668 in Saskatchewan only
FAX: (306) 780-9263
E-mail: info@naturesask.ca
Web: www.naturesask.ca

MEMBERSHIP APPLICATION FORM

❑ New Member ❑ Renewal

Name (please print) .....
Address .....
City .....Prov..... Postal Code.....
Phone .....Fax ..... E-Mail.....

❑ Change of Address: Please write in new address above
❑ Gift Membership:
Name (please print).....
Address.....
City ..... Prov.....Postal Code .....
Phone..... Fax.....E-Mail.....

Category	One Year	Three Year	Five Year
Individual	❑ $25	❑ $65	❑ $95
Family	❑ $30	❑ $75	❑ $115
Student	❑ $15		
Senior (>64 years)	❑ $20	❑ $50	❑ $75
Outside Canada	❑ $30	❑ $75	❑ $115
Institutional	❑ $30		
Life	❑ $600		

I wish to make a tax creditable donation to Nature Saskatchewan:

❑ General Programs $ _____
❑ Grasslands Trust Fund $ _____
❑ Last Mountain Bird Observatory $ _____
❑ Operation Burrowing Owl $ _____

Fee Total
Nature Saskatchewan Membership $ _____
Nature Saskatchewan Donation $ _____
TOTAL $ _____

I would like to pay by: ❑ Cheque ❑ Visa ❑ Mastercard

Cardholder's Name: _____

Credit card number __/__/__/__/__/__/__/__/__/__/__/__/__/__/__/__/

Expiry date __/__/ __/__/ Signature _____

Make cheques and money orders payable to NATURE SASKATCHEWAN.

Mail to: Nature Saskatchewan
206 - 1860 Lorne Street
Regina, Saskatchewan S4P 2L7

* **Do you know** of any person interested in natural history and conservation who does not receive the Blue Jay? Please send their name and address and we will send a sample Blue Jay and an invitation to join our Society.

Renew by Phone!
Call toll-free: 1-800-667-4668 (Saskatchewan only) or (306) 780-9273
Fax (306) 780-9263
to renew by Visa or Mastercard

Figure 2. Adult marsh wren (Cistothorus palustris) *caught at the new Wascana Centre MAPS station.* *See article by Clarke & Ewart on p. 174.* *Jared Clarke*

Mystery photo. How many birds can you count in this picture?

Harvey Schmidt

Nature SASKATCHEWAN

Publication Mail Agreement #40063014
Return Undeliverable Canadian Addresses to:
Administration Centre Printing Services
111-2001 Cornwall Street
Regina, SK S4P 3X9
Email: adminprint@sasktel.net